Fishery Data Series No. 11-53

Fish Inventory and Anadromous Cataloging in Eastern Norton Sound Drainages, 2009

by

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and

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November 2011

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

FISHERY DATA SERIES NO. 11-53

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ADF&G Fishery Data Series was established in 1987 for the publication of Division of Sport Fish technically oriented results for a single project or group of closely related projects, and in 2004 became a joint divisional series with the Division of Commercial Fisheries. Fishery Data Series reports are intended for fishery and other technical professionals and are available through the Alaska State Library and on the Internet: http://www.adfg.alaska.gov/sf/publications/. This publication has undergone editorial and peer review.

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ABSTRACT

During August 20–25, 2009, the Alaska Department of Fish and Game, Division of Sport Fish, in cooperation with the Bureau of Land Management, Anchorage Field Office, conducted an inventory of fish assemblages and associated aquatic and riparian habitats in an 11,300 square-km study area comprising Norton Sound drainages between the Shaktoolik and Klikitarik rivers. Thirty-three study sites were visited in streams ranging in size from headwaters to the mainstem Unalakleet River. At each site, data were collected describing site location, aquatic habitat, riparian vegetation, and fish–assemblage composition. Fish were collected primarily using backpack and boat-mounted electrofishers. In total, 11 fish species, representing 7 genera and 4 families, were identified. Anadromous fish were documented at 20 study sites. As a result of this inventory, a total stream length of 165 km of previously unlisted anadromous fish habitat was added to the State of Alaska's *Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes*.

Key words: fish inventory, stream survey, anadromous, Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes, Anadromous Waters Catalog, electrofishing, Unalakleet River, Shaktoolik River, Golsovia River, slimy sculpin, *Cottus cognatus*, Dolly Varden, *Salvelinus malma*, Arctic grayling, *Thymallus arcticus*, coho salmon, *Oncorhynchus kisutch*, pink salmon, *Oncorhynchus gorbuscha*, round whitefish, *Prosopium cylindraceum*, chum salmon, *Oncorhynchus keta*, Chinook salmon, *Oncorhynchus tshawytscha*, sockeye salmon, *Oncorhynchus nerka*, lamprey, *Lampetra sp.*, ninespine stickleback, *Pungitius pungitius*.

INTRODUCTION

The State of Alaska is committed to conserving fish habitat. Alaska is the only state with a constitutional mandate[1] to maintain sustained yields of fish stocks (ADCCED 2009), and the Alaska Department of Fish and Game (ADF&G) has a statutory responsibility to manage the use of wild fish stocks for sustained yield (AS 16.05.730(a)). Along with proper management of harvests, protection of fully functioning and connected aquatic habitats is necessary to sustain fish stocks supporting Alaska's commercial, subsistence, and recreational fishing economies.

The state has multiple administrative tools to protect fish habitat. Alaska Statute (AS) 16.05.871 (the Anadromous Fish Act), along with the Fishway Act (AS 16.05.841, which requires that fish passage be maintained in any stream "frequented by salmon or other fish"), constitute Alaska's strongest and most comprehensive instream fish-habitat protection standards. Several other Alaska statutes specifically reference fish habitat, including multiple sections in AS 41.17 (Forest Resources and Practices Act) and AS 46.15 (Water Use Act), both administered by the Department of Natural Resources, and AS 46.03.758 (Civil penalties for discharges of oil), administered by the Department of Environmental Conservation.

The Anadromous Fish Act requires ADF&G to "specify the various rivers, lakes and streams or parts of them" of the state that are important to the spawning, rearing or migration of anadromous fish. The *Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes* (Anadromous Waters Catalog, AWC) and its associated atlas are the media used to accomplish this specification, and are adopted as regulation under 5 AAC 95.011. Activities and uses conducted in, or otherwise affecting, either any AWC-listed water bodies (under the Anadromous Fish Act), or fish passage in any fish-bearing waters (under the Fishway Act) statewide, require prior approval from the ADF&G Division of Habitat, which is responsible for reviewing project plans and specifications submitted by permit applicants.

[1] The Constitution of the State of Alaska; Article 8, Section 4 – Sustained Yield states "Fish, forests, wildlife, grasslands, and all other replenishable resources belonging to the State shall be utilized, developed, and maintained on the sustained yield principle, subject to preferences among beneficial uses."

Permitting biologists work closely with project applicants to ensure that project plans provide for the proper protection of fish habitat. If so, a Fish Habitat Permit is issued authorizing the activity. Permit applications may be denied if impacts to fish habitat cannot be adequately avoided, minimized, or mitigated.

Many other federal, state, and local government policies specify additional protections for anadromous fish habitat in Alaska. Like the Anadromous Fish Act, however, these only apply to those waters where anadromous fish use is explicitly documented, typically by reference to the AWC. For example, the National Marine Fisheries Service (NMFS) identifies Essential Fish Habitat (EFH) for Alaska stocks of Pacific Salmon in freshwater by reference to the AWC. Three of the U.S. Army Corps of Engineers' regional conditions for nationwide permits in Alaska specify additional requirements and restrictions for proposed projects located in or near AWC-listed water bodies. Other policies that protect AWC-listed water bodies are found in: area plans for state lands; state forest management plans; resource management plans for Bureau of Land Management (BLM) lands; federal and state regulations specifying waters closed to commercial and subsistence fishing; and city and borough ordinances.

Comprehensive fish-distribution information is required for effective land-use, conservation, and restoration planning to identify sensitive and important habitats. State land-management plans, such as the *Susitna Area Plan* and the *Bristol Bay Area Plan*, and more specific plans such as the *Kenai Peninsula Brown Bear Conservation Strategy*, identify management guidelines or specify geographic areas of concern based in large part on the known distribution of fish. Watershed and conservation planning efforts also rely heavily on knowledge of fish distributions and aquatic habitat characteristics and their spatial and temporal relationship to other resources and activities. Planning for habitat-restoration programs, such as fish-passage enhancement, is also better informed with access to comprehensive fish-distribution information.

Resource developments, such as transportation and utility corridors, are most-effectively informed if complete fish distribution data is available at project onset. If comprehensive fish-distribution information is provided during project scoping, projects can be designed to avoid habitat impacts; however, absence of comprehensive fish-distribution information can lead to unintended fish habitat impacts.

All these fish-habitat conservation authorities and planning processes are limited, however, by the extent of current knowledge of fish habitats and their distribution. The Anadromous Fish Act, along with other federal, state, and local government policies that refer to the AWC, provides protection only to those waters listed in the AWC. Listing new water bodies requires site-specific, direct, and unambiguous observations of anadromous fish followed by a biological and public-review process. Habitat modeling, speculation, or professional judgment is not sufficient to add water bodies to the AWC.

Previous field inventories have demonstrated significant data gaps in the understanding of Alaskan freshwater fish distribution and habitat characteristics. For example, recent (2003–2008) anadromous-cataloging work resulted in a 75% increase in the sum of the lengths of AWC-listed streams, and a 72% increase in the number of cataloged water bodies, in the Nushagak River drainage. The state has limited authority to protect anadromous fish habitat not listed in the AWC.

To refine fish-habitat management in specific waters, resource agencies also need knowledge of local aquatic and riparian habitat characteristics. Since aquatic and riparian habitats vary in their

sensitivity to human activities, these habitat characteristics should be well understood when planning or permitting general or specific activities. Physical and biological characteristics of riparian and aquatic habitats are important factors in determining appropriate best-management practices and mitigation strategies. Therefore, at each fish-collection reach, variables were recorded describing water quality, channel morphology, and riparian vegetation to provide basic habitat information needed to:

1. develop fish-habitat permit stipulations, or;
2. specific further sampling needs and methods necessary to design adequate habitat-protection stipulations or mitigation for permitting moderate or higher-level disturbances.

Documenting aquatic and riparian habitat characteristics at fish-collection reaches also provides baseline information for comparison with future studies, and may also contribute to improved understanding of fish–habitat associations.

In the Alaska Freshwater Fish Inventory (AFFI) program, we strive to proactively prepare for management information needs. Historically, fish-habitat surveys in Alaska have focused almost exclusively on sites considered imminently threatened, or actively impacted, by human activities. While a reasonable and necessary approach, it is not a sufficient strategy to ensure the sustainability of Alaska's freshwater fish resources. With this reactive approach, fish-habitat data collections and analyses often do not occur early in project development trajectories, and results may arrive too late to contribute to major management decisions, or to effectively inform project design. The historic approach of investigating only imminently threatened or actively impacted habitats also constrains the range of scientific inference that can be made with collected data. Our whole-watershed approach for AFFI investigations complements local, site-based fish studies by providing fish-distribution and aquatic-habitat information to decision makers early in the project-scoping process and by providing baseline information to assess relationships between fish and natural habitats, unconfounded by local anthropogenic habitat alterations.

In response to the above needs, in August 2009 we conducted a rapid, baseline inventory of fish distribution and associated aquatic and riparian habitat characteristics in the eastern Norton Sound drainages in Western Alaska. A long-term goal of the AFFI program is to complete a baseline inventory of freshwater fish habitats statewide. So far, since 2002, we have inventoried selected streams and rivers in 28 of Alaska's 136 subbasins, including study areas in Cook Inlet, Bristol Bay, Seward Peninsula, Central Yukon-Tanana, Upper Kuskokwim River, Lower Yukon-Innoko, Middle Kuskokwim River, and Eastern Norton Sound drainages.

STUDY AREA

The 11,300 square-kilometer (sq. km) study area selected for inventory in August 2009 (Figure 1) included all watersheds draining into eastern Norton Sound between the Shaktoolik River and the Klikitarik River, inclusive. Major river systems in the study area included: the Shaktoolik River; the Unalakleet River; and the Golsovia River. This study area was chosen for fish inventory fieldwork based on: gaps in AWC coverage; information on human activities and infrastructure; land conservation status; and availability of funding.

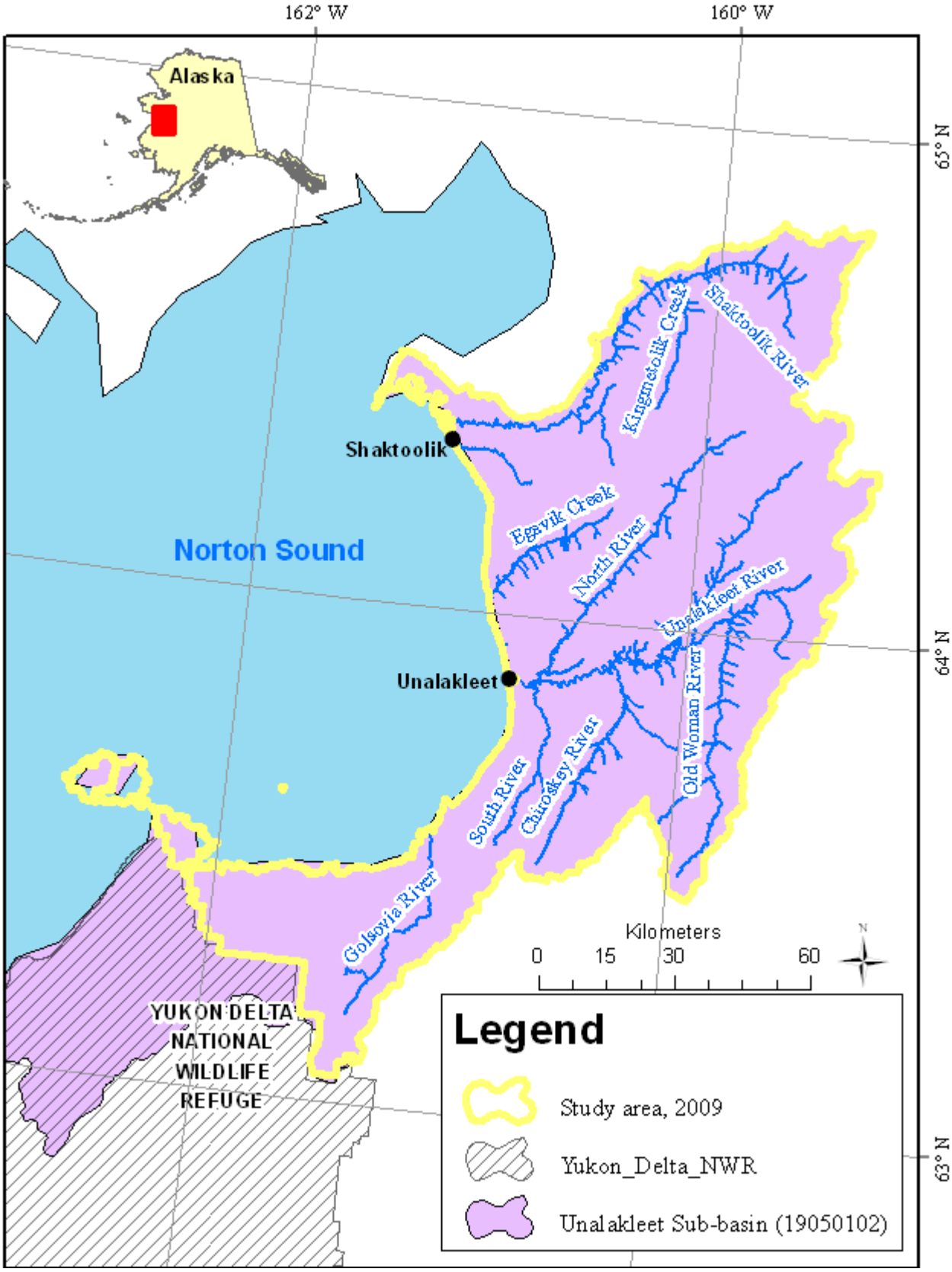

Figure 1.–Hydrologic units (subbasins) comprising project study area.

Prior Fish Studies in the Study Area

Most prior fish studies in the study area focused on species and life stages targeted by commercial, sport, or subsistence fisheries located in the lower reaches of the Unalakleet and Shaktoolik rivers. Efforts to document fish-assemblage composition, including juveniles, have been more limited, especially in low-order streams. Various management entities have operated a counting tower on the North River (largest tributary of the Unalakleet River) sporadically since 1972 (ADF&G 1972–1974, 1984–1986; Kawerak Inc. 1996–2001; Native Village of Unalakleet 2002–2008) for the original purpose of enumerating salmon solely in the North River (Kent 2010; Kohler 2002a), but more recently to provide an index for drainagewide salmon escapement estimates (Joy et al. 2005; Kent 2010; Wuttig 1999). Since 1985, ADF&G has managed a test net fishery on the lower Unalakleet River to assess salmon stock metrics, run timing, and escapement variables (Kent 2010; Kohler 2002b). A variety of radio-telemetry projects have been implemented to estimate the abundance and track the timing and movements of various salmon species (Estensen et al. 2007; Joy et al. 2005). ADF&G Chinook salmon stock assessments have shown that the Unalakleet and Shaktoolik river Chinook salmon runs have been in decline since 2000 and have been designated a stock of yield concern by the Alaska Board of Fisheries (http://www.adfg.alaska.gov/index.cfm?adfg=process.main) each year since 2004 (Kent and Bergstrom 2009).

In the 1970s and ’80s, the BLM conducted fish inventories in several Norton Sound drainages, including the Inglutalik, Koyuk, Shaktoolik, and Ungalik river systems (personal communication, Dave Parker, BLM Fish Biologist, Fairbanks, April 2011). As a result of these inventories, the following species were documented: Arctic grayling; round whitefish; Arctic char (most likely Dolly Varden under their current delineations); pink; Chinook; chum and coho salmon; slimy sculpin; and northern pike. In 1988, the BLM operated a weir and counting tower on the Shaktoolik River (Mitch Wagener, Seasonal Biologist, BLM, Shaktoolik River Coho Salmon Project, unpublished data, 1988) with the intent of enumerating coho and chum salmon and Dolly Varden migrations. As a supplementary objective, an effort was made to aerially locate and map specific spawning areas and upper spawning limits of Chinook, chum, coho, and pink salmon and Dolly Varden in the Shaktoolik River drainage. As a result, Chinook salmon were observed spawning in the Shaktoolik River nearly as far upstream as the Kingmetolik Creek confluence, while chum and pink salmon were observed spawning primarily in Kingmetolik Creek as far upstream as 10 miles from its mouth. Coho salmon, though uncommon, were observed spawning in the lower reaches of Anakeksik Creek.

Based on the above studies, and Mecklenburg et al. (2002) and Morrow (1980), the following 22 fish species occur in the study area:

- Arctic lamprey (*Lampetra camtschatica*)
- longnose sucker (*Catostomus catostomus*)
- northern pike (*Esox lucius*)
- Alaska blackfish (*Dallia pectoralis*)
- pond smelt (*Hypomesus olidus*)
- rainbow smelt (*Osmerus mordax*)
- humpback whitefish (*Coregonus pidschian*)
- least cisco (*Coregonus sardinella*)
- Bering cisco (*Coregonus laurettae*)
- round whitefish (*Prosopium cylindraceum*)
- sheefish (*Stenodus leucichthys*)
- Arctic grayling (*Thymallus arcticus*)
- chum salmon (*Oncorhynchus keta*)
- pink salmon (*Oncorhynchus gorbuscha*)
- coho salmon (*Oncorhynchus kisutch*)
- sockeye salmon (*Oncorhynchus nerka*)
- Chinook salmon (*Oncorhynchus tshawytscha*)
- Dolly Varden (*Salvelinus malma*)
- burbot (*Lota lota*)
- ninespine stickleback (*Pungitius pungitius*)
- threespine stickleback (*Gasterosteus auleatus*)
- slimy sculpin (*Cottus cognatus*)

OBJECTIVES

The overall goal of the AFFI program is to provide information needed for management of the habitats that support Alaska's freshwater fishes. This project contributed to that goal by achieving the following objectives:

Objective 1: To maximize the spatial increase of mapped anadromous fish habitat depicted in the AWC by completing a baseline inventory of fish (with emphasis on anadromous fish) assemblages within the Unalakleet subbasin draining to eastern Norton Sound.

Task 1: Locate fish-collection reaches to maximize the spatial increase of specified anadromous fish habitat in targeted drainages while minimizing the number of study sites per water body. At each reach, record GPS coordinates and the occurrence and type of natural or anthropogenic barriers to fish passage.

Task 2: Sample each reach using standardized fish collection techniques and sufficient sampling effort to collect or observe all common species and life stages of the fish assemblage present in the reach at the time of sampling.

Task 3: Record the species, life stage, number, and fork length of all fish collected, and record the species, life stage, and (estimated) number of visually observed (but not collected) fish from each fish-collection reach. Describe the fish collection effort and extent of area sampled.

Task 4: For each water body in which anadromous fish are observed, submit a nomination to the AWC, providing sufficient information to achieve the intended result (i.e., addition, deletion, correction, or backup information).

Objective 2: To record characteristics of aquatic and riparian habitats at each station such that sufficient information is documented to: (a) identify well-supported and adequate habitat protection stipulations for permitting of local low-level disturbances; or (b) identify specific further sampling needs necessary to design adequate habitat protection stipulations or mitigation for permitting moderate or greater-level disturbances.

Task 1: Record a suite of standard aquatic habitat parameters at each station.

Task 2: Characterize the dominant riparian vegetation communities at each station.

Objective 3: To develop and evaluate adaptive decision processes (stopping rules) to guide fish-inventory field crews in estimating when a sufficient length of stream has been sampled at each nonwadeable (200- and 1500-sq. km target streams[2]) fish-collection reach to meet Objective 1, Task 2.

Task 1: 200-sq. km target streams: At each 200-sq. km target stream, record fish observations separately for each of a minimum of 10 spatially sequential subreaches (each equivalent in length to 10 channel widths). Additional subreaches will be sampled as necessary until no new fish species are recorded from 6 consecutive subreaches.

Task 2: 1500-sq. km target streams: At each 1500-sq. km target stream, record fish observations separately for spatially sequential subreaches (each equivalent in length to 10 channel widths). As many subreaches as possible will be sampled each day.

Task 3: Based on field data collected at the 200- and 1500-sq. km target streams, develop appropriate stopping rules for single-pass electrofishing in nonwadeable rivers of Western Alaska.

[2] Target stream classification is described in methods.

METHODS

The following sections (Study Area Selection, Target Streams, Fish-Collection Reaches, and Stations) describe how we determined, prior to fieldwork, *where* to conduct this project. The Fish-Collection Methods section and Aquatic- and Riparian-Habitat Assessment section describe the fish-collection and habitat-characterization protocols followed during fieldwork.

Because of a lack of road access to target streams within the study area, this project was supported by helicopter (a Robinson R-44[3] and a Bell 206BIII) and by a 13-ft inflatable boat equipped with an outboard motor with jet drive. Teams were based at the ADF&G house in Unalakleet, which provided adequate support facilities and was relatively centrally located within the study area.

On each team, one person was the designated crew leader, based on experience with similar surveys and knowledge of the goals, objectives, and protocols of this project. Each crew leader was responsible for all aspects of the field operations of a team, such as determining the daily sequence of target stream visits, and selecting the location of fish-collection reaches. The other crewmember(s) assisted with all data collection responsibilities.

STUDY AREA SELECTION

The study area boundaries were based on watershed boundaries, with certain conservation units excluded. We adopted the national hydrologic-unit classification (Seaber et al. 1987) as our spatial framework. The entire nation is divided and subdivided into successively smaller hydrologically based spatial units: regions, subregions, basins, and subbasins. Alaska comprises an entire region (19), divided into 6 subregions: Southeast (1901); Southcentral (1902); Southwest (1903); Yukon (1904); Northwest (1905); and Arctic (1906). These 6 subregions are further divided into 33 basins and 136 subbasins.

The subbasin is the hydrologic unit that most closely matches the size of a typical AFFI fish inventory project study area; therefore, the subbasin was chosen as the fundamental spatial unit for prioritizing and implementing AFFI projects.

The study area for 2009 was comprised of the 12,982 sq. km Unalakleet subbasin (19050102 [Figure 1]). 1,682 sq. km of this subbasin located on the Yukon Delta NWR was excluded from this study area due to sufficient environmental protection standards already in place, leaving 11,300 sq. km for this study area. We chose the Unalakleet subbasin as the study area for this project because:

- To meet requirements of funding agencies, the study area needed to be located in the intersecting portion of the BLM-AFO and Pacific Coastal Salmon Recovery Fund (PCSRF) Arctic/Yukon/Kuskokwim (AYK) region boundaries;
- the Unalakleet subbasin supports intensive and highly valuable commercial and sport fisheries, yet there appeared to be substantial gaps in AWC coverage; and
- the Unalakleet subbasin contained a substantial portion of BLM-AFO high-priority lands for anadromous cataloging.

[3] Product names used in this report are included for scientific completeness, but do not constitute a product endorsement.

TARGET STREAMS

Information gaps in the AWC may include unlisted anadromous water bodies as well as unlisted anadromous species or life stages from listed water bodies. By comparing the extent of AWC-listed water bodies to the extent of all mapped water bodies in the study area, we determined there was likely a substantial number of unlisted streams that may be used by anadromous fishes. Additionally, it appeared likely that there were numerous listed streams where additional anadromous species and life stages could be added, particularly large rivers. So we defined 3 sets of candidate target streams based on upstream drainage area, including 50-sq. km (wadeable) and 200- and 1500-sq. km (nonwadeable) target streams. From these 3 sets, we selected a prioritized set of target streams, as described below.

50- and 200-Sq. Km Target Streams

Due to the large number of unlisted 50- and 200-sq. km streams in the study area, we identified a prioritized subset as target streams, as described below.

Selection of 50-sq. km target streams

From previous experience, we anticipated that we could survey an average of 6 reaches in wadeable streams per day, and we expected that an average of 1.25 reaches per target stream would need to be visited to approximate the upstream extent of anadromous fish distribution. Expecting there would be some inaccessible target streams, either due to lack of a suitable helicopter landing zone or lack of a wadeable study reach, we increased the projected number of target streams by 10%. Therefore, we identified and ranked 32 wadeable target streams (6 reaches per day x 6 days/1.25 reaches per target stream x 1.1 = 32 target streams).

To maximize AWC additions, we ranked each potential target stream by the length of stream channel located between the upstream terminus of AWC coverage, and the point along the stream where the upstream watershed area first reached 50-sq. km. We do not understand enough about the ecological factors that may limit anadromous fish distribution in the study area to include additional calculable criteria (e.g., valley gradient) in our target stream selection process.

Candidate target streams (i.e., all non-AWC-cataloged, or unsubstantiated AWC streams in the study area draining at least 50 sq. km) were selected and ranked using a GIS-based protocol as follows:

1. All 50-sq. km catchment outlets (pourpoints) within the study area were plotted[4].
2. Pourpoints located on AWC-cataloged stream segments were deleted; however, any pourpoints located on unsubstantiated AWC water bodies (i.e., AWC-listed water bodies for which no nomination form exists in AWC files, from a GIS layer provided by J Johnson, ADF&G Habitat Biologist, April 2, 2008, Anchorage, Alaska) were not deleted.

[4] The source GIS layer for identifying target streams in the study area was the National Elevation Dataset (NED), which is a digital elevation model (DEM) with a 60-m cell size throughout our study area. We clipped the NED to the extent of our study area, then reconditioned it by "burning-in" NHD flowlines using Arc Hydro Tools version 1.2 for ArcGIS 9.2 (available at http://support.esri.com/index.cfm?fa=downloads.dataModels.gateway). Then we used GIS hydrology tools (bundled with the Spatial Analyst extension for ESRI ArcGIS 9.2) to generate a flow accumulation grid from the reconditioned NED. Finally, we plotted a catchment outlet overlaying each flow-accumulation grid cell where the accumulated number of upstream cells first equaled or exceeded 13,889, which corresponded to the 50-sq. km threshold identified for wadeable streams. In Step 3 above, stream distances were measured along flowpath lines derived from the flow accumulation grid.

3. The length of stream from each 50-sq. km pourpoint downstream to the upper terminus of AWC coverage was measured and recorded using an ESRI ArcInfo script. Where more than one 50-sq. km pourpoint draining to the same AWC terminus was identified, we determined which pourpoint had the longest flowpath downstream to the AWC terminus, and recorded the length of that flowpath. Then we recorded the length of the next-longest flowpath measured only to the confluence with the longest flowpath determined in the previous iteration. This step was repeated until a flowpath length was recorded for each 50-sq. km pourpoint that shared a common downstream AWC upper terminus.
4. We sorted the list of pourpoints in descending order by their recorded flowpath length, and sequentially numbered them from 1 to *n* until the number of ranked pourpoints equaled 32. Thus, the pourpoints were ranked, giving priority to those that would potentially add the greatest length of stream to the AWC.
5. The set of wadeable target streams comprised the streams flowing through the selected pourpoints.

Selection of 200-sq. Km Target Streams

Using the same ranking methods as we used for the 50-sq. km team, and anticipating that we would visit only one 200-sq. km target stream per day during each of the 6 field-days, we selected 8 candidate 200-sq. km target streams, anticipating that conditions may prevent access to some target streams.

1500-Sq. Km Target Streams

We selected as target streams both 1500-sq. km streams in the study area, the Unalakleet and Shaktoolik rivers. Both of these rivers were previously listed in the AWC; therefore, the emphasis for Objective 1 was to update the AWC with the diversity of fish species and life stages found in these rivers.

We anticipated that we would have sufficient time to sample 4 reaches in 1500-sq. km target streams during the 6 field-days, so we selected 2 reaches (downstream and upstream) on both the Unalakleet and the Shaktoolik rivers.

FISH-COLLECTION REACHES

Sampling Sufficiency

Since collecting all common species of the local fish assemblage was the primary task, we essentially sampled for fish species richness. According to Temple and Pearsons (2007), when species richness is the primary variable of interest, linear sampling distances should be based on multiples of wetted channel width (CW). Several recent studies have estimated the amount of stream length that should be sampled to capture most (typically 90–95%) of the species present in a given stream reach (Table 1). Based on studies (i.e., Patton et al. 2000, Reynolds et al. 2003, Temple and Pearsons 2007) from regions with similarly low species richness as in Alaska, we selected a standard reach length of 40 CW for wadeable streams, a standard which has been in place during previous AFFI projects since the 2003 field season.

Recent analysis of prior (2007–2008) AFFI fish collections indicated that single-pass electrofishing in a standard 40-CW reach typically underestimates true species richness in Medium (100–500 sq. km) streams of Western Alaska (personal communication, Daniel Reed,

ADF&G Biometrician, June 2008, Nome, Alaska). Therefore, to better ensure that all common species were detected in 200-sq. km target streams, during this project we implemented a prototype adaptive decision process (stopping rule; described under Objective 3, Task 2) to estimate when a sufficient length of stream has been sampled at each fish-collection reach.

Table 1.–Recommended number of stream widths that should be sampled to capture common species present.

No. of stream widths	Region	Reference
	Wadeable streams	
5–49	southern Wisconsin	Lyons 1992
22–67	Virginia	Angermeier and Smogor 1995
13–83	South Carolina	Paller 1995
12–50	Wyoming	Patton et al. 2000
86	Arkansas	Dauwalter and Pert 2003
40	western Oregon	Reynolds et al. 2003
27–31	Yakima basin, WA	Temple and Pearsons 2007
	Nonwadeable rivers	
85	Oregon	Hughes et al. 2002
30–40	Idaho	Maret and Ott 2003

Fish-Collection Reaches in Wadeable Target Streams

To ensure adequate sampling effort occurred in the smallest wadeable streams, and to avoid spending an excessive amount of time in the largest wadeable streams, fish-collection reach lengths were limited to 150–300 m in all wadeable streams. This range (150–300 m) of potential fish-collection reach lengths was consistent with the National Water-Quality Assessment Program (NAWQA) protocols for sampling fish assemblages (Fitzpatrick et al. 1998) and with recommendations developed for small Wyoming streams (Patton et al. 2000). Thus, in fish-collection reaches having a wetted-width < 3.75 m, actual reach length exceeded 40 CW; and in reaches having a wetted-width > 7.5 m, reach length was less than 40 CW.

Individual fish-collection reaches on 50-sq. km target streams were selected in the field by the crew leader during slow, low-level helicopter reconnaissance. Target stream reconnaissance generally began at the 50-sq. km catchment outlet and proceeded up the mainstem. As the helicopter flew upstream at altitudes and speeds sufficiently low to allow adequate visual inspection, the crew leader evaluated the stream, paying particular attention to water flow, gradient, and barriers to fish passage. The crew leader selected a fish-collection reach meeting the following criteria. A reach:

1. At or near the apparent upstream limit of anadromous fish distribution.
2. Where the crew leader anticipated anadromous fish could be present, based on observable characteristics including: fish observed from the air; stream substrate; velocity; juxtaposition of aquatic habitat types; known seasonal variation in instream flow; and accumulated experience in evaluating the presence of anadromous fish in adjacent and similar water bodies.

3. Having a safe helicopter landing zone located within a 5-minute walk of the stream.
4. Where prior approval to access private, native, military, or municipal lands has been provided [5].

In some cases, the crew leader judged that the target stream was not likely to provide anadromous-fish habitat, and that the objective of maximizing AWC additions would be better served by devoting effort to another water body. In such cases, the crew leader took an aerial photograph(s) of the target stream, then directed the pilot to the next target stream.

If anadromous fish were collected from a reach, and in the absence of migratory barriers upstream, additional upstream sampling may have been conducted at the discretion of the crew leader. Conversely, if no anadromous fish were collected from a reach, the crew leader could select another fish-collection reach further downstream. These options were weighed against the need to meet that day's quota of study reaches, which was adaptively established by the crew leader.

Fish-Collection Reaches in 200-Sq. Km Target Streams

Helicopter reconnaissance of 200-sq. km target streams began at the upstream terminus of AWC coverage, then we proceeded upstream slowly and at low-level toward the 200-sq. km catchment outlet. As the helicopter traveled up the target stream, the crew leader evaluated the channel's aquatic habitat, paying particular attention to water flow, gradient, barriers to fish passage, and any potential rafting hazards (e.g., rapids, sweepers, falls). The crew leader selected a segment of the target stream for the day's float meeting the following criteria. A segment:

1. That could be safely floated in a day.
2. Where the crew leader anticipated anadromous fish could be present, based on observable characteristics including: fish observed from the air; stream substrate; velocity; juxtaposition of aquatic habitat types; known seasonal variation in instream flow; and accumulated experience in evaluating the presence of anadromous fish in adjacent and similar water bodies.
3. Having a safe helicopter landing zone within a 5 minute walk of the stream at both the upstream (put-in) and anticipated downstream (take-out) ends of the segment.
4. Where the landing zones at the put-in and take-out points, and the fish-collection reach, were on lands where previous access approval had been obtained.

Each day, we sampled one reach in a 200-sq. km target stream. At each reach, we recorded fish observations separately for each of a minimum of 10 spatially sequential subreaches (each equivalent in length to 10 CW). Additional subreaches were sampled as necessary until no new fish species were recorded from 6 consecutive subreaches.

[5] ADF&G is responsible for the sustainability of all fish and wildlife throughout Alaska, regardless of land ownership. No prior permission is needed for ADF&G to access study sites located on state or BLM lands. As outlined by the Master Memorandum of Understanding (MOU) between ADF&G and BLM, BLM recognizes the right of ADF&G to enter onto BLM lands at any time to conduct routine management activities. Under the MOU, ADF&G informs BLM of the project and estimated dates but does not need formal permission for these activities. However, on other lands (e.g., private, native, municipal, or military), prior permission is needed for ADF&G to access study sites where a helicopter cannot land within the ordinary-high-water zone, which is often the case in 50- and 200-sq. km target streams (Since 1500-sq. km target streams are accessed by boat, approval to access these sites is typically not needed). To identify any study sites where prior approval was needed for access, 50- and 200-sq. km catchment outlet points were plotted on land-status maps. From inspection of these maps, we determined that prior approval was not required to access any of our access study sites.

Fish-Collection Reaches in 1500-Sq. Km Target Streams

Since all the 1500-sq. km target streams were already listed in the AWC prior to this project, the emphasis when selecting fish-collection reaches was on documenting locations supporting the maximum diversity of anadromous fish species and life stages. We used satellite imagery (i.e., Google Earth) and geospatial data layers such as the National Elevation Dataset (NED), National Hydrography Dataset (NHD), and AWC to locate potential fish-collection reaches in advance in segments of target streams expected to provide aquatic habitat conditions suitable for a variety of fish species and life stages, according to the following criteria. A reach:

1. That could be safely accessed by jet boat, and was located within a day's drive or less (up to approximately 75 river miles) from where the jet boat was expected to be parked at the end of the previous day.
2. Located immediately downstream of a major tributary, or
3. Located in a suspected upwelling area, as indicated by:
    a. A broad active floodplain located upstream of a constriction (visible in satellite imagery), or
    b. Channel approached the toe of a steep hillslope.

At each 1500-sq. km reach, we recorded fish observations separately by subreach (each subreach was equivalent in length to 10 CW). We sampled as many spatially sequential subreaches as possible in one day, while allowing sufficient time to visit all their target streams.

FISH-COLLECTION METHODS

The goal was to collect all common species in the local fish assemblage. Single-pass electrofishing was the principal fish collection method, supplemented on a limited basis by other gear types (i.e., angling, dip net, or visual observations) when electrofishing was not feasible. To determine where to end each electrofishing reach, crewmembers used a handheld, consumer-grade GPS unit (Garmin GPSMap 60CSx or 76S) in trip-computer mode to measure the distance traveled from the starting point. Standard electrofishing protocols (Appendix A1 and Appendix A2) were followed to minimize stress to fish, for operators' safety, and in an attempt to standardize sampling efforts between locations and operators so results were comparable between locations and across time. In wadeable streams we used a Smith-Root model LR-24 battery-powered backpack electrofisher, and in nonwadeable streams we used a Smith-Root model GPP 2.5 generator-powered electrofisher. Operators were instructed to cease electrofishing in the immediate vicinity of aggregations of large (> 300 mm) salmonids, except to capture a fish if necessary to confirm its specific identity.

At the end of the reach, the fish were processed according to the protocol detailed in Appendix A3, and electrofisher settings and fish observations were recorded in the database. All collected fish were identified to species, and fish fork lengths (measured from tip of snout to fork of tail [or to tip of tail, if no fork]) were measured to the nearest mm. Up to approximately 30 fish of each species and life stage were measured from each study site—any additional fish were identified and tallied. Where more than 30 fish of a given species and life stage were collected, in order to avoid biased sampling of fish to be measured, we measured every *n*th fish removed from the bucket, where the value of *n* was the estimated number of fish of a given species and life stage collected, divided by 30. For each fish, we recorded species (Appendix B5), life stage

(Appendix B1), life history (anadromous, resident, marine, unknown), and anomalies in fish appearance or condition (Appendix B2, *sensu* McCormick and Hughes 1998). If spawning by a given species was not directly observed, but the crew leader thought (based on indirect evidence such as external morphological characteristics, behavior, condition, expression of gametes when handled, or presence of newly emerged young) the species likely spawns within or near the study reach, "suspected spawning" was recorded in the database for the given species. In addition to recording fish that were collected, we also recorded counts (by species and life stage—estimates were allowed) of additional fish that were observed, but not collected. Any definite barriers to fish passage (Appendix B3) were recorded.

After being identified, measured, and allowed a period of recuperation (before being measured, fish were generally sedated using buffered CO_2—see Appendix A3), all fish (except specimens retained for further study) were released. Dolly Varden pelvic fin clips were retained in ethanol and delivered to the USFWS Conservation Genetics Laboratory in Anchorage for genetic analysis. An overdose of carbon dioxide was used to euthanize 160 Dolly Varden (up to 12 from each study site where they were collected) to be retained (frozen) for further study to detect anadromy using otolith trace elements to indicate periods of saltwater residency. In the lab following fieldwork, we extracted the pair of sagittal otoliths and recorded standard meristic data from each retained fish.

See Table 2 for a list of variables associated with fish-collection events and fish catch that were recorded at each study site.

Fish-Collection Protocols in Wadeable Streams

See Appendix A1 for detailed fish-collection protocols for wadeable streams.

After establishing a station location in a 50-sq. km target stream, we multiplied the wetted channel width by 40 to calculate the reach length to be sampled. A minimum reach length of 150 m was adopted for target streams having a wetted width < 3.75 m, and a maximum reach length of 300 m was applied to target streams having a wetted width > 7.5 m. Crewmembers sampled the fish assemblage according to protocols detailed in Appendix A1.

The backpack electrofishing system used in 50-sq. km streams was a Smith-Root LR-24 fitted with a standard Smith-Root rattail cathode (a 10-ft length of braided, 3/16-in stainless-steel cable with the connected end insulated with a 6-ft length of neoprene) and a single anode pole having a standard Smith-Root (11 inch diameter) stainless-steel anode ring.

A pulsed-direct-current (pulsed-DC) rather than a smooth-DC waveform was selected to extend battery life. Pulse frequency was typically set at 30 (did not exceed 50) pulses per second (pps) to avoid exposing fish to more harmful higher pulse frequencies. A minimum electrofisher on-time of 300 s per fish-collection reach was required to ensure an adequate minimum level of electrofishing effort.

While collecting fish, the electrofisher operator worked in an upstream direction, zigzagging between the banks, sampling all accessible habitat types, with an emphasis on cover (e.g., large substrate elements, large wood, debris piles, undercut banks, aquatic macrophyte beds, overhanging vegetation). A second crewmember followed closely, collecting fish with a fiberglass-handled dip net as detailed in Appendix A1.

Fish-Collection Protocols in Nonwadeable Streams

See Appendix A2 for detailed fish-collection protocols for nonwadeable streams.

To meet Objective 3, in 200-sq. km streams, we typically sampled as many additional 10-channel-width subreaches as time allowed.

In 1500-sq. km streams, we used an inflateable 13-ft boat with a 25-hp 2-stroke outboard motor with jet drive. The following electrofishing system was set up on the jet boat (Figure 2.A): a Smith-Root GPP 2.5 generator-powered electrofisher and control box with 2 Smith-Root SAA-6 adjustable spider-array electrodes (one wired as an anode and the other wired as a cathode) suspended from two 9-ft. Smith-Root electrode booms extending out over the bow. To ensure the cathode surface area was greater than that of the anode (for optimal electrofisher efficiency), the cathode was suspended deeper in the water than was the anode. A boat operator seated near the stern maneuvered the boat with either a 25 hp outboard jet motor or oars, depending on specific river conditions, while a second operator controlled the electrofishing system and collected fish with a fiberglass-handled dip net while standing in the bow.

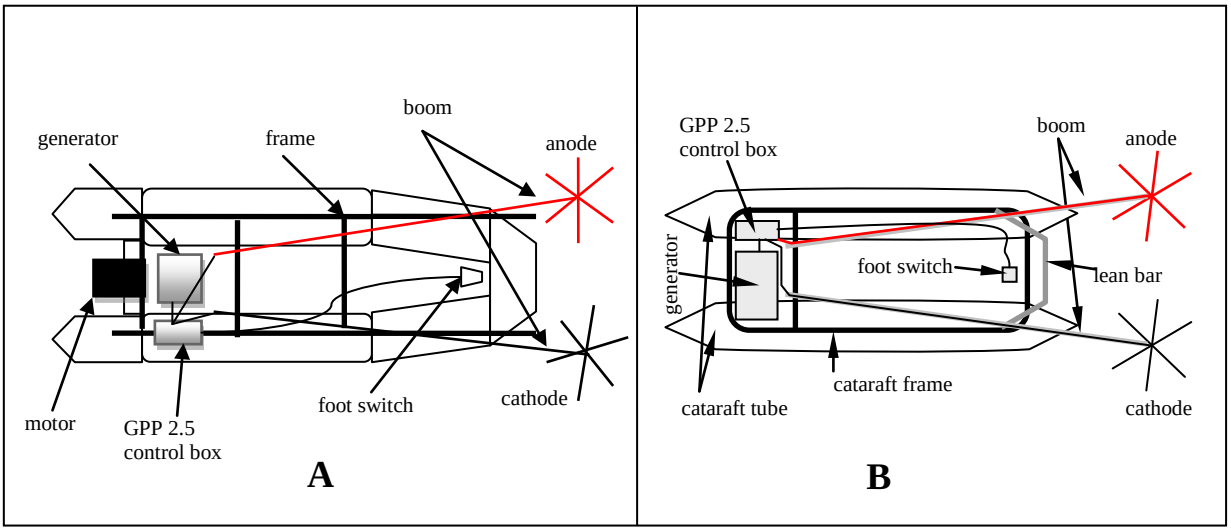

Figure 2.–Jet-boat (**A**) and cataraft (**B**) electrofishing system schematic.

In 200-sq. km target streams, we used an Outcast model PAC 1200 cataraft measuring 13-ft long and 65-in wide, with a load capacity of 750 lbs.. The electrofishing setup on the cataraft (Figure 2.B) was similar to that of the jet-boat, except no outboard motor was available.

During fish collection, the driver maneuvered the boat laterally (across the current) while drifting downstream, while a second operator controlled the electrofishing system and collected fish with a fiberglass-handled dip net while standing in the bow. A pulsed-DC waveform was selected. Pulse frequency was typically 30 pps, but did not exceed 60 pps, to avoid exposing fish to more harmful higher pulse frequencies.

STATIONS

A single point location, which we called the station, was established for each study-site visited. At each station, we marked a waypoint using a handheld, consumer-grade GPS receiver (Garmin GPSMAP 60CSx or 76S), and recorded the GPS error (horizonal error value displayed by the GPS unit). We typically defined a station as the point location of the habitat transect. The station also

typically corresponded to the location of the upstream terminus of the fish-collection reach. A second GPS waypoint was also saved at the downstream end of each fish-collection reach.

When we aerially observed an aggregation of adult fish spread throughout a stream segment, we marked the locations of the downstream and upstream segment termini and entered the total (estimated) count of fish observed (by species and life stage). In this case, the upstream limit of the fish aggregation was defined as the station. Additionally, locations of other relevant aerial observations—such as: target streams lacking a suitable landing zone; target streams deemed unlikely to support anadromous fish use; target streams deemed to be inaccessible or nonwadeable; waterfalls or other potential or historic migratory barriers (Appendix B3); or other features of interest—were marked and entered into the database as stations with any associated observations annotated in the database as comments.

A unique 5-character alphanumeric identifier (Station ID) was assigned to each station. The structure of the Station ID was:

1. the first 2 characters represented the sequential survey day (e.g., 01, 02…)
2. the third character represented the team making the observation (e.g., A, B, …). For this project, Team A sampled the 1500-sq. km streams; Team B sampled the 200-sq. km streams; and Team C sampled the 50-sq. km streams.
3. the fourth and fifth characters (e.g., 01, 02, …) represented the sequential station number visited on a given survey day. Note that the station number (4^{th} and 5^{th} characters of the Station ID) began at 01 at the start of each survey day.

For example, Station 04C05 was the 5^{th} station visited by Team C on the 4^{th} field day. The entire project was assigned a unique Project Code, FSW09. The combination of Project Code and Station ID therefore insured a universally unique identifier for every station.

See Table 2 for a list of variables associated with station location and visit information that were recorded at each study site.

AQUATIC AND RIPARIAN HABITAT ASSESSMENT

At each site where fish collection was attempted, we also measured a suite of habitat variables describing water quality, channel dimensions, stream flow, and riparian vegetation. See Table 2 for a list of habitat variables, along with information about instruments used, units and domains, and precision of measures.

We established a habitat transect perpendicular to the direction of flow across a representative (of the fish-collection reach), non-pool channel unit. In selecting the habitat-transect location, we looked for:

1. A straight section, ideally a glide or run, where streamlines were parallel to each other, where
2. The streambed was relatively uniform and free of numerous boulders and heavy aquatic growth, and
3. Flow was relatively uniform and free of eddies, slack water, and excessive turbulence.

In pool-riffle stream reaches, the habitat transect was typically located in the transition between a pool and riffle. Most habitat variables were assessed at the habitat transect (station); however,

some variables (i.e., stream gradient, substrate composition, and riparian vegetation) were assessed over a short (e.g., 5-channel-widths) stream section spanning the habitat transect.

We measured 4 water-quality variables (temperature, pH, dissolved oxygen, conductivity) with a YSI 556 multi-probe meter with a built-in barometer (used in calibrating dissolved oxygen). The pH, dissolved oxygen, and conductivity sensors were calibrated[6] weekly (or more frequently if readings were suspect). To measure these variables, we placed the probe in flowing water as near to the thalweg[7] as practical, and waited for the readings to stabilize before recording them. We measured turbidity with a LaMotte 2020e turbidimeter, which was calibrated daily using 0- and 1-, 10-, or 100-NTU standards (depending on the estimated turbidity of the sample). We collected a water sample for turbidity analysis from flowing water as near to the thalweg as practical. We also visually assessed water color (Table 2 and Appendix B4).

To measure stream gradient, we measured the water-surface angle (%) between consistent channel features (e.g., top of riffle to top of riffle) along the longest, straightest stream section in the vicinity of the habitat transect. To characterize substrate composition, we visually (or, in turbid water, by feel under-foot, or with a pole) assessed the 3 most dominant substrate classes (Appendix B4) below the bankfull level[8] in a 5-channel-width (up to 100 m maximum) stream section centered on the habitat transect. In wadeable streams < 30 m wide, channel widths were measured using a fiberglass tape stretched horizontally across the stream between the left and right bank bankfull marks (bankfull width) and wetted edges (wetted width); and thalweg depths were measured as the vertical distance from the thalweg to the water surface (wetted thalweg depth) and bankfull level (bankfull thalweg depth). In nonwadeable streams, or where channel width exceeded 30 m, channel widths were measured using a laser range finder, and wetted depth was measured with a handheld sonar device. To calculate bankfull depth in nonwadeable streams, we added the wetted depth to the estimated distance from the water surface to the bankfull level. We used a clinometer to aid in estimating the bankfull level by sighting to bankfull indicators on the banks and moving the clinometer up or down to achieve a level sighting.

We assessed stream flow qualitatively by visually estimating thalweg velocity (still, slow, medium, or fast) and stream stage (low [much of scoured streambed is exposed], medium [water is below bankfull level, but covers most of scoured streambed], high [water is near or above bankfull level]). Recent (within approximately the past 48 hours) precipitation (None/Trace, Moderate, Heavy) was noted. In nonwadeable streams we estimated thalweg (surface) velocity as the maximum sustained GPS ground speed of the boat drifting in the thalweg. In wadeable streams, we estimated stream velocity by timing the procession of an orange floated in the thalweg along a predetermined section of stream.

In a reach 5-channel-widths long (up to 100 m maximum) centered at the habitat transect, we visually assessed the dominant riparian vegetation community (*sensu* Viereck et al. 1992) and measured its canopy height in each of the following 8 zones (4 zones on each bank): 0-5 m (from

[6] The pH sensor was calibrated with pH 4, 7, and 10 standards. The dissolved-oxygen sensor was calibrated in water-saturated air. The conductivity sensor was calibrated with a 1 mS/cm conductivity standard.

[7] Path of a stream that consistently follows the deepest part of the channel (Armantrout 1998).

[8] The bankfull level is commonly defined as the water level at which a stream begins to flow onto the floodplain. However, since the floodplain may be narrow or undetectable in entrenched streams, and because downcutting or channelization may result in the channel being disconnected from its former floodplain, observers should always look for additional indicators when identifying bankfull level. Other than the presence of an active floodplain, the principal indicators of bankfull level (Leopold 1994) are: top of point bar; change in vegetation (e.g., bare gravel to herbs; alders above bankfull level); topographic break (vertical stream bank to horizontal floodplain; horizontal bar surface to vertical bank); change in substrate size; or flood-deposition debris.

bankfull mark); 5-10 m; 10-20 m; and 20-30 m. We estimated canopy heights < 1.5 m with a graduated rod, and canopy heights > 1.5 m with a clinometer and range finder[9].

We took ground and aerial photographs (minimum resolution was 2,560 x 1,920 pixels [about 5 megapixels]) with a compact, point-and-shoot digital camera. GIS was later used to derive the elevation of each station from the National Elevation Dataset digital elevation model.

Following fieldwork, we assigned a level-II Rosgen (1994) code to classify the channel type at each station located in a lotic habitat. To determine channel type, we used site photos and stream-gradient and dominant-substrate values collected during fieldwork, along with estimates of: (1) the width/depth ratio, estimated from bankfull width and depth values collected in the field; (2) the entrenchment value, estimated from the bankfull width measurement, along with an estimate of floodprone width from site photos, and; (3) sinuosity, calculated using GPS tracks, site photos, or NHD hydrography. For lentic habitats, we adopted 5 additional channel-type classes developed by Michael Wiedmer (retired ADF&G Habitat Biologist, personal communication, December 2009, Seattle, WA), including: Lake/Pond; Slough; Beaver-pond complex; Wetland; and No defined channel.

DATA COLLECTION AND REDUCTION

Other than derived values that were computed later, we directly entered all measured or observed values in the field (while at the station) into a Microsoft Access relational database (MDB) using a ruggedized notebook or tablet computer. Wherever appropriate, the MDB used drop-down lists or validation rules (e.g., for continuous data within an acceptable range of values, such as pH values restricted to 0–14).

In base camp, at the end of each field day, crew leaders error-checked all data recorded that day. Each team's MDB file, GPS-unit files (waypoints and tracks), and digital photographs were backed up each day onto a thumb drive and then transferred to a laptop computer, which was securely stored and transported separately from the field computers.

After the field season, all the teams' MDBs were aggregated and checked for nonsensical values. Original GPS waypoints were downloaded from the GPS units in their native WGS84 datum. Then, using ESRI ArcGIS software and GIS layers, we derived additional station-location information (USGS quadrangle name, USGS HUC code, meridian, township, range, section, AWC Region, elevation) for each station. These values were then appended into the compiled MDB.

Data from the compiled MDB was then replicated to the AFFI database (AFFID), a Microsoft SQL Server database, for long-term usage. Accessing AFFID data for staff review, editing, and reporting is primarily achieved through a Microsoft-Access Data Project (ADP). SQL Server is also used to provide raw data and web-based reports for the Internet using ESRI ArcGIS server, Adobe ColdFusion, and related GIS applications, along with other appropriate and available map layers (e.g., topographic maps, hydrography, land-ownership coverage).

Table 2 lists the variables that were typically recorded at each study site, along with any associated instruments, measurement units and precision (continuous variables), and domain (list of possible values of categorical variables). See Appendix B for lookup tables of lengthier domain lists.

[9] Canopy height was estimated by multiplying the horizontal distance to a representative tree (measured with a range finder) by the angle (%; measured with a clinometer) to the top of the tree, then adding the clinometer height above the level of the base of the tree.

SAMPLING DATES

Fieldwork was completed during August 20–26, 2009, which was consistent with prior AFFI surveys in 2002–2008. In order to meet Objective 1, fieldwork was timed to coincide with the period during which anadromous fishes rearing in headwater streams (i.e., age 0 and 1 coho and Chinook salmon) were presumed to be at or near their maximum upstream distribution. This period was expected to occur during July–August, after coho and Chinook salmon fry emerged and dispersed from natal habitats, but prior to the onset of rapidly cooling waters in the fall, when rearing fish were thought to begin downstream movements to winter habitats.

DATA ANALYSIS

Stream-Size Groups

In order to compare fish occurrence and distributions of habitat variables across stream sizes, we grouped the reaches sampled based on drainage area (sq. km) upstream of the habitat transect as follows: Wadeable (Small) streams, ≤100 sq. km; Nonwadeable streams, >100 sq. km. For most of the data summaries and tables in the Results section and appendices, we further subdivided the Nonwadeable streams into Medium (100–500 sq. km) and Large (>500 sq. km) streams.

Typically, reaches sampled in 50-sq. km target streams were categorized as Small, 200-sq. km target streams as Medium, and 1500-sq. km target streams as Large streams. However, in one of the 6 reaches sampled from the set of 200-sq. km target streams, the reach was located farther downstream where the drainage area exceeded 500 sq. km, so this reach was classified as Large instead of Medium for the purpose of data analysis. In other words, in order to find a location meeting the specified criteria for a suitable fish-collection reach (e.g., a reach which the crew leader determined to be safe, accessible and likely to support anadromous fish) in this 200-sq. km target stream, the crew leader selected a fish-collection reach draining >500 sq. km.

Graphical Summaries of Frequency Distributions

We created a variety of graphs (Appendix G1) to display frequency distributions of categorical variables. We created side-by-side box plots[10] to graphically display the distributions of selected numeric habitat variables and visualize how distributions of each variable differ within stream-size (Appendix G2) and species-occurrence (Appendix G4) groups. Likewise, we created side-by-side box plots to visualize how fish fork length distributions varied between species and among stream-size groups (Appendix G3). We derived catch per unit effort (CPUE) as the number of fish collected per hour while electrofishing and created box plots summarizing CPUE for each species, within stream-size groups (Appendix G5). We created frequency histograms to display meristics data from Dolly Varden specimens retained for an otolith-chemistry study (Appendix I1).

Supplemental Data Analyses

When we examined side-by-side box plots of numeric variables grouped by stream size (Appendices G2 and G3) and species occurrence (Appendix G4), it appeared there were some variables having distributions that differed among groups. So we ran 2-tailed randomization

[10] The box plots in this report display the median (50th percentile) as a black dot (●), and the 1st (25th percentile) and 3rd (75th percentile) quartiles as the lower and upper ends of the box. The ends of the whiskers represent the lowest value still within 1.5 IQR (interquartile range, i.e., the difference between the 3rd and 1st quartiles) of the 1st quartile, and the highest value still within 1.5 IQR of the 3rd quartile. Outliers (values beyond 1.5 IQR) are represented as open circles.

tests (Manley 1997) to test for differences in medians among stream-size groups (Small vs Medium, Small vs. Large, and Medium vs. Large streams; 100,000 simulations each; Appendices H1 and H2) and species-occurrence groups (species found vs. not found; 100,000 simulations for Wadeable streams, 10,000 simulations for Nonwadeable streams; Appendix H3). For some species, the sample sizes (i.e., number of reaches where the species was found or not found) in Nonwadeable streams were not adequate to further subdivide the Nonwadeable streams into Medium and Large subgroups—for these species, we left the group of Nonwadeable streams intact and just compared Wadeable vs Nonwadeable streams using 10,000 simulations.

In previous studies, we noticed that certain species often seemed to occur at the same site, whereas other species tended not to occur together. So we also examined the data within each stream-size group to detect evidence that pairs of fish species either tended to be associated or that they demonstrated a tendency to not occur at the same sites. We constructed contingency tables (2x2) for each pair of species to test the null hypothesis that the occurrence of species A at a site was independent of the occurrence of species B. Fisher's Exact Test was used to evaluate the null hypothesis for each pair of species because contingency table cell counts were frequently small (<5) and expected values for cell counts were frequently < 1.0 (Agresti 1990). Regardless of the significance of test results, nominal positive or negative association between each pair of species was determined by examining marginal values for each contingency table.

Objective 3—Sampling Sufficiency

True species richness (*TSR*) was estimated for each 200- and 1500-sq. km fish-collection reach where sampling-sufficiency data were collected, and compared to observed species richness (*SR*), the total number of species found in a reach. For a site *i*, where data are collected over a series of n_i subreaches, *TSR* and *SR* were compared at the conclusion of each subreach beginning with the 4th subreach and continuing to the n_ith subreach.

A Horvitz-Thompson estimator (Cochran 1977) was used to estimate *TSR*. For each observed species *s* in *SR* in the sample of n_i subreaches for site *i*, the probability that this species was detected in one subreach was estimated:

$$\hat{p}_{s,i} = \frac{n_{s,i}}{n_i} \tag{1}$$

where $n_{s,i}$ is the number of subreaches n_i where species *s* was detected. We then calculated the probability that the species would not have been detected by sampling n_i subreaches:

$$1 - \hat{p}_s = \left(1 - \hat{p}_{s,i}\right)^{n_i} \tag{2}$$

From which we can directly calculate $\hat{p}_s$, and estimate the probability that the species can be detected at site *i* with n_i sampled subreaches. The Horvitz-Thompson estimate of *TSR* was calculated as a sum across all detected species:

$$TSR_{H-T} = \sum_{j=1}^{SR} \frac{1}{\hat{p}_s}. \tag{3}$$

The analytical formulae presented in Cochran (1977) for estimating the sampling variance of the Horvitz-Thompson estimator when p_s is estimated (not known with certainty) are not stable for small sample sizes. We are in the process of evaluating a bootstrap approach (Efron and Tibshirani 1993) for estimating variance using the type of data collected in this project.

Table 2.–List of variables collected during fieldwork.

Variable name	Equipment	Units/Domain	Precision	Comment
Geographic information				
Station ID	-	text	-	
Station location Downstream end of reach	consumer-grade GPS unit (Garmin GPSmap 60CSx or 76S)	decimal degrees (WGS84 datum): latitude (DD.DDDDD); longitude (-DDD.DDDDD)	0.00001 degrees	
GPS error		m	1 m	
Water-body name	Water-body name from USGS topo map	text	-	
Geographic comments	-	text	-	Describes location of study site in relation to adjacent long-term or permanent geographic features
Visit information				
Observers	-	list of field staff	-	
Date/time	field notebook computer	mm/dd/yyyy hh:mm:ss	1 s	Value input automatically from computer's clock when data entry is begun
Camera counter	-	sequential integers	-	List of photo filenames (last 3 digits only) associated with each station
Visit comments	-	text	-	Physical and biological conditions at the station during the visit--focus on ephemeral conditions, such as weather or stream conditions, or the dynamics of riparian conditions, that may help explain other recorded observations
Wildlife comments	-	text	-	Anecdotal wildlife observations, particularly those that relate to fish.
Water quality				
Water temperature	YSI 556 meter	°C	0.01 °C	
pH		pH units	0.01 pH units	
Dissolved oxygen		mg/L	0.01 mg/L	
Conductivity		µS/cm	1 µS/cm	Ambient conductivity (not temperature corrected)
Turbidity	LaMotte 2020e turbidimeter	NTU	1 NTU	
Water color	-	see Appendix B4	-	

-continued-

Table 2.–Page 2 of 3.

Variable name	Equipment	Units/Domain	Precision	Comment
Stream channel				
Channel width (wetted and bankfull)	30-m fiberglass tape	m	0.1 m	In wadeable channels < 30 m wide
	laser range finder (Bushnell Yardage Pro)	m	1 m	In nonwadeable channels, or where width > 30 m
Thalweg depth (wetted and bankfull)	handheld sonar (HawkEye Digital Sonar) and clinometer (to find the OHW level)	m	0.1 m	1500-sq. km Team
	graduated rod	m	0.01 m	50- and 200-sq. km Teams
Stream gradient	clinometer (Sokkia 5x magnifying abney level with clinometer, or Suunto PM-5)	%	0.1%	Water surface slope. Not typically measured by 1500-sq. km Team.
Substrate composition	-	see Appendix B4	-	3 variables: dominant; subdominant (1); subdominant (2)
Channel type	see Channel width & depth and Stream gradient	Rosgen (1994) level-II channel types, plus the following: Lake/Pond; Slough; Beaver pond complex; Wetland; or No defined channel	-	
Stream flow				
Qualitative thalweg velocity	-	still, slow, medium, fast	-	Estimated visually
Stream stage	-	low, medium, high	-	Water level relative to OHW.
48-hour precipitation	-	none/trace, moderate, heavy	-	
Thalweg velocity	Orange and stopwatch	m/s	0.01 m/s	50-sq.km Team only; time the procession of an orange floated in the thalweg along a measured stream section.
	consumer-grade GPS unit (Garmin GPSmap 60CSx or 76S)	m/s	0.1 m/s	1500-sq. km Team only; maximum sustained GPS velocity of boat drifting in thalweg
Riparian vegetation communities				
Riparian vegetation composition	-	Viereck et al. (1992) vegetation communities	-	Dominant vegetation community recorded in 8 zones (4 zones on each bank): 0-5 m (from OHW mark); 5-10 m; 10-20 m; 20-30 m
Riparian vegetation canopy height	graduated rod (< 1.5 m); clinometer & range finder (> 1.5 m)	m	0.1 m (< 1.5 m); 0.5 m (>1.5 m)	Recorded for each of the 8 zones described above

-continued-

Table 2.–Page 3 of 3.

Variable name	Equipment	Units/Domain	Precision	Comment
Fish-collection events				
Event location	-	upstream, downstream, centered, at station	-	Location of fish-collection reach relative to station (habitat transect)
Channel	-	main channel, side channel, off channel	-	Channel description of fish-collection reach
Fish-collection method	-	backpack electrofisher, boat electrofisher, visual observations (ground, boat, or helicopter), dipnet, angling, none	-	
Voltage	electrofisher setting	V	1 V	
Frequency		pulses per second (pps)	1 pps	
Duty cycle		%	1%	(LR-24 only)
Current	electrofisher output meter	A	0.01 A (LR-24); 0.1 A (GPP 2.5)	Peak current (LR-24); average current (GPP 2.5)
Power	electrofisher output meter	W	1 W	Peak power (LR-24 only)
Electrofisher on-time	electrofisher timer	s	1 s	
Efficiency	-	excellent, good, fair, poor	-	Perceived electrofishing efficiency, relative to optimal environmental conditions
Catch				
Species	-	list of Alaskan freshwater fish species	-	
Life stage	-	see Appendix B1	-	
Life history	-	anadromous, freshwater-resident, marine, unknown, N/A	-	
Suspect spawning	-	yes, no	-	
Barrier	-	see Appendix B3	-	
Fork length	fish measuring board	mm	1 mm	
Sex	-	male, female, blank (if sex was not determined)	-	
Anomalies	-	see Appendix B2	-	
Individual fish comments	-	text	-	Comments pertaining to an individual fish
Additional counts	-	integer--no. of fish	1 fish	
Estimated	-	yes, no	-	Indicates whether the no. of additional fish recorded above was an estimate or a direct count

RESULTS

All field data were recorded in the AFFID, and AWC nominations were submitted by September 15, 2009. As a result of the 20 AWC nominations generated by this project, a total stream distance of 165 km of previously unlisted salmon habitat (including Chinook, coho, chum, and sockeye salmon) was added to the AWC (Figure 4 and Appendix E1). Additional anadromous species or life stages were documented in 5 previously cataloged streams. Data summaries, including individual study-site reports and digital photos, are available on the AFFID internet mapping service website at http://www.adfg.alaska.gov/index.cfm?adfg=ffinventory.main, and are also included in Appendix J of this report. We created maps to display study-site locations (Appendix C) and fish distribution, by species (Appendix D).

We attempted to collect fish at a total of 33 reaches, including twenty-four 50-sq. km target streams, six 200-sq. km target streams, and three 1500-sq. km target streams. Single-pass electrofishing was the primary fish-collection method at all 33 fish-collection reaches. At one reach (17C03), we did not have enough time to collect habitat variables, or sample a complete reach, so we spot-shocked to quickly sample for fish presence. Where electrofishing was not feasible (e.g., equipment malfunctioned, nonwadeable or nonboatable target streams, no suitable helicopter landing zone), no sampling effort took place; only 2 sites visited fell into this category. At these 2 sites, we marked a GPS waypoint and took aerial photos.

We sampled 24 of the set of 32 (75%) 50-sq. km target streams. The remaining 8 unsampled streams were relatively low ranking (in terms of the distance that could be added to the AWC) or were deemed by the crew leader as unlikely to support anadromous fish.

We started with a set of eight 200-sq. km target streams, of which 6 (75%) were ultimately sampled; the remaining 2 were not expected to provide anadromous fish habitat and were bypassed. We sampled 3 of our initial set of 4 (75%) 1500-sq. km target stream reaches. One reach was not sampled due to difficulty with gear transportation.

For the 32 fully sampled reaches, reach length varied from 150 m (the minimum reach length for wadeable streams) to 2,800 m. Of the 23 wadeable reaches in which we collected habitat variables, 5 were in the wetted-width range ($\leq$ 3.75 m) requiring a 150-m long reach, 15 were within the range (3.75–7.5 m) calling for a 40-CW-long reach, and 3 were in the range ($\geq$ 7.5 m) calling for a 300-m-long reach. In the 9 nonwadeable reaches, we sampled as many subreaches (each 10 CW in length) as needed to meet Objective 3. Therefore, reach length was variable in nonwadeable streams, ranging from 100 to 130 CW.

We found fishes from 4 families and 11 species (Table 3), 8 of which were members of the salmonid family. Salmonids were found at all of the 33 electrofished reaches, and cottids (sculpins) at 27 (82%) reaches. We found at least 1 anadromous fish at 20 (60%) of the 33 electrofished reaches. 3 species (slimy sculpin, Dolly Varden, coho salmon) were each found in >60% of the sampled reaches; conversely, the remaining 8 species were each reported from $\leq$21% of the 33 electrofished reaches.

Table 3 lists the number of electrofished reaches in which each fish species occurred, grouped by stream size. In the group of Large streams as a whole, we found all 11 of the fish species identified during this project. We found a total of 9 species (all but lamprey sp. and ninespine stickleback) in the group of Medium streams. In the group of Small streams we found only 4 species (coho salmon, Dolly Varden, ninespine stickleback and slimy sculpin). Dolly Varden

were the most widely distributed species, occurring at 32 of the 33 (97%) electrofished reaches, followed by slimy sculpin occurring in 27 (82%) reaches.

We found Dolly Varden in 23 of the 24 (96%) electrofished Small-streams, followed by slimy sculpin in 18 (75%), then coho salmon in 11 (46%). These 3 species co-occurred in 9 (38%) Small streams. We found ninespine stickleback in only 1 (4%) of the electrofished Small-streams. Dolly Varden, slimy sculpin and coho salmon co-occurred in all 5 of the Medium-streams, and Chinook salmon and Arctic grayling were also found in 4 of the 5 (80%). We found Dolly Varden, Arctic grayling, coho salmon and slimy sculpin in all 4 of the electrofished Large-streams. See Table 3 for more information on species occurrence.

Appendix F1 summarizes fish occurrence by life stage. Only *Adult* round whitefish, pink salmon, chum salmon, and sockeye salmon; and *juvenile* lamprey life stages were found (no other life stages were found for these species). Slimy sculpin and Dolly Varden were the only species for which both juveniles and adults were reported from all 3 stream-size groups. Juvenile Arctic grayling and juvenile ninespine stickleback were collected from Large streams only. No adult coho salmon or juvenile ninespine stickleback were observed in Small streams. Juvenile, adult, and spawning adult Dolly Varden were observed in both Medium and Small streams.

Appendix G1 shows frequency distributions of dominant riparian vegetation communities (*sensu* Viereck et al. 1992). In Small streams, from 0–10 meters from the edge of the scoured stream channel, shrub types (especially tall willow) were the most frequently occurring riparian-vegetation communities. From 10–30 m, shrub types (especially tall willow) continued to dominate, although forest types (especially black spruce) began to appear. In Medium streams, from 0–10 m, unvegetated banks dominated, however shrub types (low willow and tall alder), and forest types (black spruce) also occurred. From 10–30 m, forest types (especially black spruce) occurred most frequently. In Large streams from 0–10 m, tall willow dominated, although both forest and herbaceous type communities were observed. From 10–30 m, shrub types (especially tall willow) dominated, although black spruce forest was also common.

Appendix G1 also shows frequency distributions of water-color and dominant substrate types, and Rosgen (1994) channel types. For all 3 stream-size classes, the water-color was found to be invariably “Clear” throughout the study area. The level-I Rosgen channel type identified most frequently in Small streams was "C" (74%), followed by "E" (13%). In Medium and Large streams, type "C" was identified exclusively (100%).

Cobble and Gravel were the only two substrate classes identified within the study area. The codominant substrate classes identified in Small streams were Cobble and Gravel (50% each). In Medium streams, Gravel (60%) dominated, followed by Cobble (40%). And in Large streams, Gravel (75%) was dominant followed by Cobble (25%). The proportion of Cobble-dominated streams decreased with stream size, while that of Gravel-dominated streams increased with stream size.

See Appendix I1 for meristics data from retained Dolly Varden specimens. Results of the Dolly Varden otolith trace-element assays will be covered in a future report.

SUPPLEMENTAL DATA ANALYSES

In Appendix G2, side-by-side box plots show distributions of selected numeric habitat variables, grouped by stream size. For each variable, Appendix H1 lists up to 3 *p*-values from

randomization tests for a difference in the medians for each pair of stream-size groups. Low (≤0.05) *p*-values suggest the medians differ among stream-size groups.

Side-by-side box plots of fork length (mm) of selected fish species, and the number of species found per electrofished reach, grouped by stream size, are shown in Appendix G3. For each species, and for the number of species found, Appendix H2 lists up to 3 *p*-values from randomization tests for a difference in the medians for each pair of stream-size groups. Low (≤0.05) *p*-values suggest the medians differ among stream-size groups.

In Appendix G4, paired box plots show distributions of selected numeric habitat variables from groups of sites where a given fish species was found versus not found, grouped by stream size. Appendix H3 lists *p*-values from randomization tests for a difference in the medians of selected numeric habitat variables, grouped by stream size. Low (≤0.05) *p*-values suggest the medians differ between groups of sites where the given species was either found or not found.

After examining *p*-values from contingency table analyses for apparent relationships (association or avoidance) between fish species found at electrofished sites, grouped by stream size, we were unable to confirm statistically any interspecific spatial relationships, with 1 exception: chum and pink salmon tended to co-occur within the study area in August.

Appendix G5 displays CPUE in side-by-side box plots separated out by species and stream size. Overall CPUE was 216 fish/h in Small streams, 134 fish/h in Medium streams, and 90 fish/h in Large streams. When separated out by species, CPUE was typically greatest in Small streams, followed by Medium and Large streams with similar levels respective to one another. An exception to this generalization was observed for Dolly Varden in Medium streams where they exhibited the highest median CPUE of any species/stream-size combination. This exception largely accounts for the higher overall CPUE observed for Medium streams as compared to Large streams.

Our inspection of species occurrence maps (Appendix D), paired box plots of habitat variables (Appendix G4), results of tests for a difference in the median of habitat variables between groups of sites where each species was found versus not found (Appendix H3), and contingency-table analyses for co-occurrence of fishes, suggest the following fish distribution patterns occur in the study area during August:

Nonwadeable streams

Lamprey sp., round whitefish, Arctic grayling, pink salmon, chum salmon, sockeye salmon, and **Chinook salmon** were observed only in Nonwadeable streams.

Lamprey sp. were found only in the Unalakleet River and, though not statistically significant due to low sample size, the elevation and gradient were both lower, and the temperature, dissolved oxygen, and turbidity higher, than in reaches where lamprey were not observed.

Round whitefish were found in 3 of the 9 Nonwadeable reaches. pH tended to be lower in reaches in which round whitefish were observed.

Arctic grayling were observed in 7 of the 9 Nonwadeable reaches. With the exception of Wadeable-stream avoidance, no significant habitat preferences were confirmed, although Arctic grayling were not found in the 2 nonwadeable reaches having the lowest conductivity.

Coho salmon, Dolly Varden and **slimy sculpin** were each found in all 9 Nonwadeable streams and therefore no evidence of interspecific association or avoidance, or habitat preference could be identified.

We found **chum** and **pink** salmon at 3 of the 9 Nonwadeable stream sites. Both of these species appeared to be more commonly observed in the lower reaches of large rivers. In the Nonwadeable streams in which pink and chum salmon were found, the upstream catchment area was greater than in reaches where they were not found. Contingency table analysis suggests that these two species tend to co-occur.

We found **sockeye salmon** in 2 Nonwadeable streams. The habitat variables associated with these two reaches did not differ significantly from the range of habitat-variable values found at sites in which they were not found.

Ninespine stickleback were found in only 1 Nonwadeable stream; the habitat variables associated with that stream did not differ significantly from the range of habitat-variable values measured at sites in which they were not found, however, in the reach where they were found, water temperature was relatively high and gradient low.

Wadeable streams

Coho salmon, Dolly Varden, ninespine stickleback, and **slimy sculpin** were the only species observed in Wadeable streams throughout the study area**.**

Coho salmon were widespread throughout the study area, occurring in 11 of the 24 Wadeable stream sites visited. In Wadeable streams where we found coho salmon, both temperature and turbidity appeared to be higher than in streams where we did not find coho salmon. Additionally, elevation, velocity, dissolved oxygen and conductivity appeared to be relatively low in reaches where they were found.

We found **Dolly Varden** in 23 of the 24 Wadeable stream sites. Elevation and gradient were lower in the single reach in which Dolly Varden were not found compared to the reaches in which they were found.

Slimy sculpin were found very frequently and were widespread in Wadeable streams. Turbidity appeared to be higher and conductivity lower in streams where slimy sculpin were found as compared to where they were not found.

Ninespine stickleback were found in only 1 Wadeable stream; the habitat variables associated with that stream did not differ significantly from the range of habitat-variable values found at sites in which they were not found.

OBJECTIVE 3–SAMPLING SUFFICIENCY

Estimates of total species richness, $TSR_{H\text{-}T}$ (Cochran 1977), were calculated for 9 reaches sampled in nonwadeable streams during the 2009 field season (Table 4).

Total species richness appeared likely to have been achieved in 5 of the 9 reaches sampled. In four of these reaches, 10 subreaches were sampled and 2 to 6 species were observed (*SR*). In the other reaches, 6 species were observed in 13 subreaches sampled. No "uncommon" species were detected in any of these 3 reaches, where an uncommon species is defined as a species observed in only 1 subreach out of all subreaches sampled.

In 4 of the 9 reaches sampled, estimates of $TSR_{H\text{-}T}$ suggested that the estimated number of species missed during sampling was between 0.50 and 1.00. In these 4 reaches, the number of subreaches sampled varied from 10 to 13, and the number of species detected varied from 5 to 9. One uncommon species was detected in each of these 4 reaches.

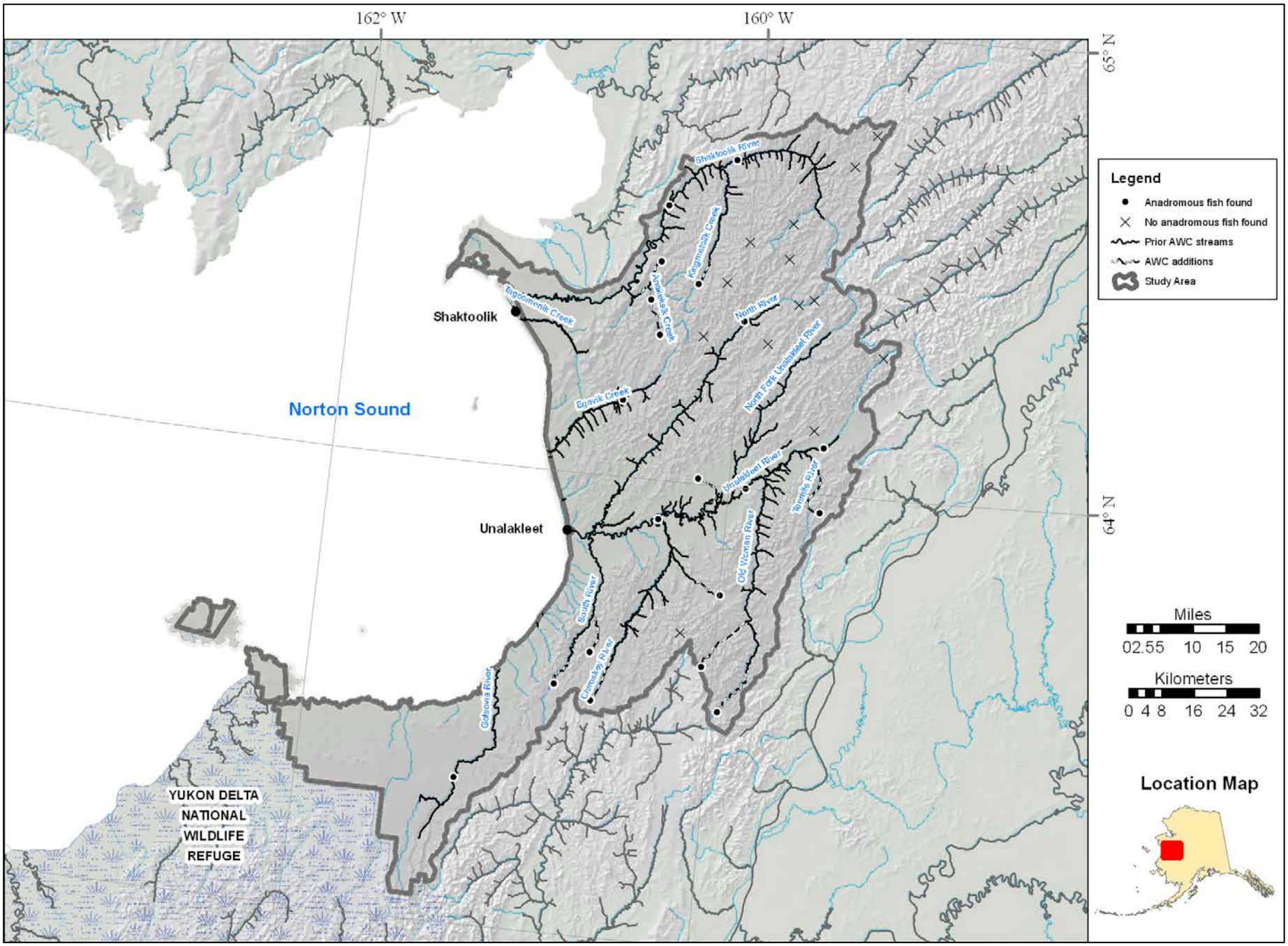

Figure 3.–Map of new or extended anadromous water bodies resulting from this project.

Table 3.–Number of reaches in which each fish species was found, grouped by stream-size category.

Family	Scientific name	Common name	Stream size[a] Small (*n*=24)	Medium (*n*=5)	Large (*n*=4)	Total (*n*=33)
Petromyzontidae	*Lampetra* sp.	lamprey-unspecified			1	1
Salmonidae	*Prosopium cylindraceum*	round whitefish		1	2	3
	Thymallus arcticus	Arctic grayling		3	4	7
	Oncorhynchus gorbuscha	pink salmon		1	2	3
	Oncorhynchus keta	chum salmon		1	2	3
	Oncorhynchus kisutch	coho salmon	11	5	4	20
	Oncorhynchus nerka	sockeye salmon		1	1	2
	Oncorhynchus tshawytscha	Chinook salmon		2	2	4
	Salvelinus malma	Dolly Varden	23	5	4	32
Gasterosteidae	*Pungitius pungitius*	ninespine stickleback	1		1	2
Cottidae	*Cottus cognatus*	slimy sculpin	18	5	4	27

[a] Stream-size categories are based on drainage area (sq. km) upstream of each reach. Small streams, <100 sq. km; Medium streams, 100–500 sq. km; Large streams, >500 sq. km.

Table 4.–Summary of sampling-sufficiency data analysis for reaches sampled in Medium and Large streams in Norton Sound, 2009.

Reach ID	Subreaches Sampled	*SR* Observed	Subreach when *SR* first observed	Horvitz-Thompson estimator (Cochran 1977) TSR_{H-T}	TSR_{H-T} minus *SR*	# of uncommon species (found in only 1 subreach)
FSW0914A011	10	8	3	8.69	0.69	1
FSW0914B011	10	4	3	4.15	0.15	0
FSW0915B011	10	6	3	6.06	0.06	0
FSW0916A011	13	9	13	10	1	1
FSW0916B021	13	6	8	6.15	0.15	0
FSW0917A011	11	5	10	5.57	0.57	1
FSW0917B011	10	3	1	3.01	0.01	0
FSW0918B011	10	5	4	5.15	0.15	0
FSW0919B011	11	5	11	5.66	0.66	1

DISCUSSION

By completing a systematic inventory of stream fish assemblages, we substantially increased Anadromous Waters Catalog coverage throughout the study area. We also documented baseline conditions (i.e., fish assemblage composition and aquatic and riparian habitat characteristics) in many streams, especially low-order streams, for which there was little or no prior information.

Fish distribution patterns from this study were generally consistent with expected patterns. As expected for coldwater streams and rivers, salmonids and sculpins dominated our catch. We typically found a greater number of fish species in Large (median of 6.5 species) and Medium streams (median of 4.5 species) than in Small streams (median of 2 species).

Of the 22 species previously documented in the study area, we found 11. We suspect some species were missing in our catch primarily because: 1) we did not sample lakes or ponds, which are preferred during the summer by whitefishes, sticklebacks, pond smelt and rainbow smelt; 2) electrofishing is inefficient in deep (> 2 m) habitats, where longnose suckers, sheefish and burbot typically are found during the day; and 3) some of these species (Alaska blackfish, northern pike) are thought to be uncommon, or have patchy distribution, in the study area.

Five lamprey ammocoetes were collected during this project, all from the Unalakleet River. We were unable to identify these ammocoetes to species, although they fit the description of Arctic lamprey (*L. camtschatica*) ammocoetes. Since Alaska Brook Lamprey (*L. alaskense*) is thought to be a derivative of *L. camtschatica*, the ammocoetes we collected could have been either *L. alaskense* or *L. camtschatica.* Attempts at species-level identification of *L. alaskense* vs. *camtschatica* using genetic tests have so far proven unsuccessful (personal communication, Daniel Rinella, University of Alaska Anchorage, Environment and Natural Resources Institute, April 28, 2010).

OBJECTIVE 3–SAMPLING SUFFICIENCY

Our objective was to develop stopping rules to guide fish-inventory field crews in estimating when a sufficient length of stream has been sampled at each fish-collection reach. More specifically, we desired to estimate the amount of stream length that should be sampled to capture most of the species present in a given stream reach.

Several recent studies have estimated the amount of stream length that should be sampled to capture most (typically 90–95%) of the species present in a given stream reach (Table 1). Hughes et al. (2002) suggest 85 stream widths (8.5 subreaches) are necessary to detect common species in nonwadeable rivers in Oregon, where the species richness per reach can be expected to be greater than in Alaska. For 6 of the 9 reaches sampled in 2009 (Table 4), the observed species richness for the reach was realized by the conclusion of the 8th subreach (80 stream widths) sampled.

Identifying the amount of sampling effort necessary to detect some percentage (i.e. 80% or 95%) of true species richness is problematic when the number of detectable species present is small (< 10). Our estimates of *TSR* were < 6 in 5 of 9 reaches we investigated.

In our analyses reported here, we have defined "uncommon" species as those that are only detecting in only one subreach in a sampled reach. For estimates of *TSR*, detection of one or more species in only one subreach will result in estimates of *TSR* that continue to exceed *SR* despite continued sampling unless these uncommon species are encountered again. For $TSR_{H\text{-}T}$, the estimated probabilities of detection/occurence of uncommon species in a subreach are a

result of how frequently they are detected in subreaches. Detection of a rare event within a reach suggests that other rare events are present, though not yet detected. Thus, detection of rare events will tend to lead to larger estimates of *TSR* than would be the case if rare events are not detected. Statistically, this is proper and correct, but it would lead to a less than functional decision tool in the field unless uncommon species can be identified (and discarded from the computations) in the field. Ideally, species should be labeled "uncommon" from an ecological perspective, rather than based solely on the rate that a species in encountered within a sampled reach.

Additional data and further investigation in this area will be necessary. Data necessary to evaluate potential stopping rules for field sampling needs to be in excess of the amount necessary to adequately sample for species richness. These data collected from 9 reaches in 2009 were adequate for this objective. However, the 2009 data provide a fairly small increment to data collected through 2008 and reported in Buckwalter et al. (2010). More detailed analyses and evaluations of potential stopping rules for sampling for *TSR* will be provided in future reports after more data are collected. Also, a stable estimation procedure or estimator for the sampling variance of the Horvitz-Thompson estimator of *TSR* needs to be developed.

RECOMMENDATIONS

1. We did not sample seven of the set of thirty-two 50-sq. km target streams and two of the set of eight 200-sq. km target streams originally selected for this project. Most of the unvisited target streams were relatively low-ranking (i.e., little distance would be added to the AWC if anadromous fish were found), or, based on prior visits to similar stream types, we did not expect to find anadromous fish in them. However, the following streams appear to be good candidates for additional anadromous-cataloging work in the study area:

Stream name	Latitude[a]	Longitude	Stream distance[b]
50 sq. km streams			
Klikitarik River	63.29723	-161.44478	21 km
Golsovia River	63.13198	-161.42687	16 km
North Fork Unalakleet River	64.38259	-159.45782	6 km
Tagoomenik River	64.22341	-160.81411	4 km
Unnamed trib. to Unalakleet River	64.1308	-159.43993	4 km
Shaktoolik River	64.58243	-159.57289	4 km
Unnamed trib. to Tagoomenik River	64.26733	-160.71302	3 km

[a] WGS84 datum. Coordinates represent the location where the upstream drainage area first reaches 200 sq. km (nonwadeable streams) or 50 sq. km (wadeable streams).

[b] Length of stream that would be added to the AWC should anadromous fish be found at this location.

2. We recommend that our electrofisher power standardization table be updated annually as our skills improve to ensure the highest level of efficiency possible and that a similar power standardization table be developed for a non-pulsed DC waveform for appropriate applications.

3. Continue the sampling sufficiency study described in this report. In the upcoming (2010) field season, to provide necessary data in Small, Medium and Large streams, we recommend sampling a minimum of 10 subreaches, and sampling additional subreaches as necessary until no new fish species are recorded from 6 consecutive subreaches.

4. To better align fieldwork with the period of maximum upstream distribution of stream-rearing anadromous salmonids, regional studies of timing of emergence and dispersal of coho and Chinook salmon fry throughout Alaska are needed.
5. Conduct research to improve our ability to distinguish lamprey species, including *L. alaskense* and *camtschatica* ammocoetes.
6. Develop a rapid lake-fish sampling protocol to be implemented, where appropriate, into the AFFI program in order to more fully describe freshwater fish (anadromous and resident) distribution throughout Alaska.

ACKNOWLEDGMENTS

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Pat Hanson and Tom Brookover reviewed the operational plan. Melanie Bosch answered innumerable budget and procurement questions. Jacque Shelley tracked our many purchases and cheerfully answered countless administrative questions. Nita Meierhoff and Terry Williamson coordinated our comings and goings and made sure we all got paid. Ryan Snow managed the database, trained crewmembers in its use, and built custom components for the cataraft. For creating beautiful field maps, as well as select maps in this report, we acknowledge Carol Barnhill. Thanks to Skip Repetto for managing the AFFID internet mapping service web site, and for writing ArcInfo scripts to identify and rank target streams. Jason Graham contributed his GIS talents to identifying land owners to contact for permission to access study sites. J Johnson received, managed, and implemented all of our AWC nominations. Tammy Burton, Norman Starkey, and Collette Bentz shared lab space and equipment for fish dissections.

Helicopter pilots Bill Snider and Chris Maurer returned everyone to camp safely every evening and volunteered their free time to help with data-collection activities. Deb Ajango trained our crewmembers on how to deal with wilderness medical scenarios. Tracey Harmon enthusiastically built, tested and adjusted a prototype inflatable jet-boat to fulfill our concept of creating a transportable sampling platform for use on otherwise inaccessible Large streams. Dick Rice trained our field crew in the proper handling of rafts and jet-boats and further instructed us on the techniques of swift-water rescue and survival. Larry Boyle instructed our crewmembers in firearm use and safety and how to work safely in bear country.

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APPENDIX A. FIELD PROTOCOLS

The objective is to collect all the common fish species from the reach. Fish collection should be completed within 30 minutes with a cumulative electrofishing time of at least 300 s. The procedure to collect fish with a backpack electrofisher (Smith-Root LR-24) is presented below.

Procedures to collect fish at wadeable sites. (adapted from McCormick and Hughes 1998).

1. Establish the station location in a straight, representative, non-pool (preferably glide or run) channel unit, and complete habitat characterization and data entry.
2. Measure wetted channel width (CW, to the nearest 0.1 m) at the station. The minimum fish-collection-reach length is 40 CW, or 150 m, whichever is greater. The maximum reach length for wadeable streams is 300 m.
3. The 2-person electrofishing team shall walk downstream, staying on the bank, the required total reach length determined in step 2 (40 CW). A handheld, consumer-grade GPS unit in trip computer mode, a hip chain, or other similarly accurate method, shall be used to measure the reach length. The team shall measure the curvilinear length of the channel, but shall avoid walking in the channel or otherwise startling fish. If walking downstream along the bank is not practicable (e.g., due to dense riparian vegetation), the team may begin electrofishing at the station, and work their way upstream the predetermined reach length while collecting fish. The location of the fish collection reach in relation to the station location should be noted in the database.
4. Both crewmembers must wear leak-free chest waders with wading belt snugly fastened, wading shoes that fit properly, electrically insulated gloves, and polarized sunglasses (preferably with amber lenses). A hat with a brim may also be helpful in reducing glare.
5. Make sure the electrofisher battery is securely fastened-in. Check electrical connections (battery, anode, cathode). Replace the battery cover securely. Try on the backpack unit, and make any adjustments to the suspension system to achieve a comfortable fit, with the unit snug against the operator's back and resting above the hip bones. If necessary, untangle and route the cathode (rat tail) and anode cables. With both electrodes out of the water and clear of each other and both operators, turn the unit on and confirm the system is ready. Reset the timer to zero. Set the waveform to pulsed DC, and adjust electrofisher output settings in the sequence listed below (adapted from Smith-Root's user manual for the LR-24 electrofisher, Rev.04, 2007) to achieve the optimal power threshold for successful electrofishing, while minimizing trauma to the fish:

    a. Select initial voltage setting according to the ambient (not temperature-compensated) water conductivity:

Conductivity (µS/cm)	Peak Voltage setting (V)
> 300	100-300
100-300	300-600
50-100	600-800
< 50	≥ 800

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b. Set pulse frequency to 30 pulses-per-second (pps).

c. Set duty cycle to achieve a pulse width of 4 ms, according to the following table:

Frequency (pps)	Duty cycle (%)
30	12
35	14
40	16
45	18
50	20
60	24

d. Ensure that the timer is reset to zero, all non-target organisms are clear of the water, and begin fishing when both crewmembers are ready.

e. If electrofishing is unsuccessful:

i. Increase the voltage by 50 V, press the enter key and try again. Stop increasing voltage when fish exhibit a forced response (twitch).

ii. If fish twitch, but are not showing taxis (induced movement of the fish toward the anode), increase the duty cycle by 10%, press the Enter key and try again. If necessary, repeat this step until fish show taxis. If the duty cycle is increased to maximum, and taxis is still not achieved, proceed to Step iii.

iii. Increase the frequency by 10 pps, and press the Enter key. Adjust the duty cycle to achieve a pulse width of 4 ms for the given frequency setting (see Step 5), and try again. Avoid frequencies >60 pps.

6. Attempt to maximize capture-prone responses (i.e, taxis, forced swimming, or loss of equilibreum) and minimize responses associated with elevated trauma (i.e., immobilization, branding, spinal deformities, or recovery period exceeding 15 seconds). Try to capture fish before they approach near to the electrodes, and remove fish quickly from the electric field.

7. Beginning at the downstream end of the sampling reach, the electrofishing team shall fish in an upstream direction, zigzagging across the channel from bank to bank in order to sample all habitat types. Depress the switch and sweep the anode slowly from side to side in the water. Electrofish intermittently to avoid herding fish, especially in glides or long pools. After electrofishing continuously for a duration of up to 5 s, quietly advance upstream approximately 2–4 m before resuming electrofishing.

   Attempt to sample the variety of habitats (deep and shallow, fast and slow, complex and simple, warmer and colder) present throughout the reach. Be sure to sample available cover (e.g., large substrate elements, large wood, debris piles, undercut banks, aquatic macrophyte beds, overhanging vegetation). Move the anode into confined cover with the power off, then depress the switch and sweep the anode away from the cover to draw fish out into open. Do not attempt to sample in or near pools greater than waist-deep, or where velocity is too fast to safely wade. Always move slowly and carefully to avoid startling fish and to minimize risk of falling.

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8. The netter follows downstream of the electrofisher operator, collecting fish with a dip net with a non-conductive handle (e.g. fiberglass) and placing them into a 5-gallon bucket with stream water for later processing. Try to net all fish seen. When this is not feasible (e.g., in highly productive systems), try to collect a representative sample of the fish assemblage (e.g., not just large game fish). Pay special attention to netting small and benthic fish, as well as fish that respond differently to the electric field—not just the big fish that move to the surface. Particularly when visibility is obscured by turbidity, debris, or vegetation, the netter should keep the dip net in the water downstream of the anode. The dip net opening should be near vertical, perpendicular to the current, with the dip net frame in contact with the substrate. The distance between the anode and the dip net is related to the current velocity: the faster the current, the greater the distance between the anode and dip net. In fast water, the net should remain several meters downstream of the anode.

9. Refresh the water in the bucket periodically to minimize physiological stress prior to measuring fish. If fish in the live well begin to show signs of excessive stress (e.g., loss of righting response, gaping, gulping air, excessive mucus), stop electrofishing and process them (Appendix A3). Also process large fish (> 300 mm) immediately and record species, life stage, life history, length, sex, and external anomalies in a notebook for future transfer to the database.

10. Record in the database the final, or most successful, electrofisher output settings (voltage, frequency, waveform, electrofisher on-time, duty cycle and typical current and power), sampling efficiency (poor, fair, good, excellent), and distance sampled, along with fish observations. If conditions prevent safe or effective electrofishing within a reach, the conditions, and their effect on sampling efficiency, should be noted in the Sampling Event tab in the database, and the length of stream that was actually sampled should be noted in Sampling Event comments. Be sure the station visit information is completely entered.

The objective is to collect all the common fish species from the reach. The procedure to sample with a generator-powered boat electrofisher unit (Smith-Root GPP 2.5) is presented below.

Procedures to collect fish by boat electrofishing. (adapted from McCormick and Hughes 2000)

Onshore at launch site

1. Check generator oil and fill tank with gas (wipe up any spillage).
2. Attach electrodes to boat, and connect their cables to the corresponding outlet on the control box. If the fishing site is distant, keep electrodes and anode poles in boat.
3. Connect generator and pulsator (contol box).
4. Confirm that all gear for the day is in the boat.
5. Put on a life jacket. Wear polarized sunglasses to aid vision.

At sample reach

1. Establish the station location in a straight, representative, non-pool (preferably glide or run) channel unit, and complete habitat characterization and data entry.
2. Measure wetted channel width (CW, in meters) at the station. The minimum fish-collection-reach length is 40 CW. For reaches being sampled to investigate sampling sufficiency, each individual sample subreach length will be 10 CW, and fish observations for each subreach must be recorded separately under a unique sampling-event code.
3. Check all electrical connections and suspend the electrodes in the water. The wetted surface area of the cathode(s) should be greater than that of the anode(s). Fill live well and put on electrically insulated gloves. Verify that all electrical switches are off, that all non-target organisms are clear of the water or 2 boat lengths away, and that both crewmembers are clear of the water and electrodes and ready to begin electrofishing. Reset the timer on the electrofisher control box to zero.
4. Switch the control box to pulsed DC, a frequency of 30 pulses-per-second (pps), low range and 40 percent voltage. Start the generator and depress the foot pedal to begin electrofishing. Increase percent (voltage) as needed to achieve the power threshold for successful electrofishing. Attempt to maximize capture-prone responses (i.e, taxis [induced movement of the fish toward the anode], forced swimming, or loss of equilibreum) and minimize responses associated with elevated trauma (i.e., immobilization, branding, spinal deformities, or recovery period exceeding 15 seconds).
5. If success is poor, reduce percent, switch to high range, and again increase percent as needed.
6. If effectiveness is still low, increase frequency to 60 pps and repeat Step 5. Switching should occur only when power is off.

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7. Select the riverbank for fishing (river-left for odd-numbered target streams, river-right for even), and stay along the selected bank through the entire reach, to the degree it is safely navigable. Position the boat so the bow is angled downstream and toward the bank. While drifting downstream, use oars (cataraft) or the outboard motor (jet boat) to maneuver laterally in the channel to avoid obstacles and position the anode(s) into habitats providing cover for fish. Most effort should occur near the bank, where most fish are expected to occur, and at depths less than 3 m wherever possible. However, all habitat types should be sampled, so zig-zag between the thalweg and the bank to allocate some sampling effort to a variety of habitats throughout the channel.

   With electrical current off, maneuver the boat so the anode(s) approach near to fish-cover elements (e.g., large substrate elements, large wood, debris piles, undercut banks, aquatic macrophyte beds, overhanging vegetation), then begin electrofishing as the boat is backed away from the cover. Electrofish intermittently to avoid herding fish, especially in glides or long pools. After electrofishing continuously for a duration of up to 10 s, drift quietly for 5–10 m before resuming electrofishing. Do not place the boat in danger in order to fish particular habitats. Cut the generator and stow the gear before negotiating hazards.

8. The netter uses a dip net with non-conductive (e.g. fiberglass) handle to retrieve fish, which are then deposited into a livewell for later processing. Try to capture fish before they approach near to the electrodes, and remove fish quickly from the electric field. Try to net all fish seen. When this is not feasible (e.g., in highly productive systems), try to collect a representative sample of the fish assemblage (e.g., not just large game fish). Pay special attention to netting small and benthic fish, as well as fish that respond differently to the electric field—not just the big fish that move to the surface. If benthic fish are being missed, hold the net behind the anode just above the bottom so some are collected.

9. Change the water in the livewell periodically to minimize stress prior to processing. If fish in the live well begin to show signs of excessive stress (e.g., loss of righting response, gaping, gulping air, excessive mucus), stop electrofishing, tie-off or land the boat on shore, and process them. This should only be necessary on very warm days, in long reaches, or if very large numbers of fish are collected. Electrofishing may also need to cease at times to immediately process and release large fish. If fish are processed and released prior to the end of a reach (or between subreaches), be sure to release them upriver, or preferably near the opposite bank, to reduce the likelihood of recapturing them.

10. Using a GPS unit in trip computer mode to monitor distance traveled, continue sampling downstream to the end of the reach. At the end of the reach (or subreach, if applicable), process the fish according to Appendix A3.

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11. Record in the database the final, or most successful, electrofisher output settings (voltage, current, frequency, waveform, electrofisher on-time, and duty cycle and power, if known), sampling efficiency (poor, fair, good, excellent), and distance sampled, along with fish observations. If conditions prevent safe or effective electrofishing within a reach, the conditions, and their effect on sampling efficiency, should be noted in the Sampling Event tab in the database, and the length of stream that was actually sampled should be noted in Sampling Event comments. Be sure the station visit information is completely entered.

Appendix A3.–Procedure to process collected fish.

1. Anesthetize collected fish with with CO_2:
    a. Add 2 buffered CO_2-producing tablets (e.g. Alka Seltzer) to a bucket containing about 4 L of stream water.
    b. Place a batch of fish in the bucket (Note: only a few fish should be anesthetized at a time to avoid prolonged sedation).
    c. Leave fish in the bucket until the desired level of sedation is achieved (about 2 to 5 minutes). Determining CO_2 dosage in the field can be difficult, because, by the time the fish have responded to the sedation, the concentration of CO_2 may be too high. If the concentration is too high (onset of sedation is rapid), the fish should be moved to native water or processed immediately.
2. Remove 1 fish at a time from the sedation bucket and place on a length-measuring tube (FL $\leq$ 250 mm) or board (FL $\geq$ 250 mm).
3. Identify all collected fish to species (Appendix B5), life stage (Appendix B1), and life history (anadromous, resident, marine/estuarine, unknown) and measure fork length to the nearest mm. Note any external anomalies (Appendix B2) and fish passage barriers (Appendix B3). Immediately after identification and measurement, place fish in a second bucket of fresh stream water for recovery. If authorized in a Fish Resource Permit, retain specimens (place them in a Zip-Loc bag or cooler, and keep them cool in stream water until they can be fixed in 10% formalin solution, or frozen) as needed to confirm identification. Take a representative photo of each anadromous species and life stage, as well as of any rare or unusual fish, fish with anomalies, or fish where ID was uncertain.
4. While 1 crewmember processes fish, the other will enter fish observations into the appropriate fields in the database.
5. Release fish to still water in the fish collection reach. If additional contiguous fish collection will be conducted, release fish downstream (50-sq. km Team) or upstream (200- and 1500-sq. km Teams), and/or along the opposite bank, to avoid their recapture.
6. Record the species, life stage, life history, and count, along with any comments indicating average size, behavior, anomalies, etc., of any additional fish that were observed, but not collected (e.g., visually observed adults).

APPENDIX B. LOOKUP TABLES

Appendix B1.–Fish life-stage classes and threshold fork-length values.

Descriptions of fish life-stage classes.

Code	Name	Description
FXE	fixed egg	Eggs adhering to or buried within a substrate.
PLE	planktonic egg	Non-adherent, bouyant or nearly so, eggs drifting with currents.
FXA	alevin	Pre-emergent sac-fry within the interstices of the substrate.
PLL	planktonic larvae	Hatched juveniles drifting with currents and with no, or poorly, developed volitional swimming capabilities.
JUV	juvenile	Sexually immature free-swimming fish.
SMT	smolt	Juvenile anadromous fish on first emigration from fresh to marine water.
JOA	juvenile/adult	Free swimming fish whose sexual maturity is not determined.
ADT	adult	Fish at, or approaching sexual maturity.
ASP	adult spawning	Adults observed in the act of spawning.
KLT	kelt	Post-spawning iteroparous anadromous fish in freshwater prior to return to marine water.
CAR	carcass	Post-spawning adult carcass.
NAP	not applicable	No fish observed or general information record only.
NRD	not recorded	Life stage not recorded.

Source: Michael Wiedmer (retired ADF&G Habitat Biologist, personal communication, January 2010, Seattle, WA).

Fork-length threshold values (mm) used to assign fish to selected life-stage classes.

	Life stage		
Species	Juvenile	Juvenile-or-adult	Adult
lamprey-unspecified	-	-	-
longnose sucker	<188	188–348	>348
northern pike	<330	330–448	>448
Alaska blackfish	<42	42–113	>113
broad whitefish	<343	343–448	>448
humpback whitefish	<280	280–363	>363
least cisco	<199	199–318	>318
round whitefish	<199	199–318	>318
inconnu (sheefish)	<586	586–648	>648
Arctic grayling	<190	190–328	>328
pink salmon	-	-	-
chum salmon	-	-	-
coho salmon	-	-	-
sockeye salmon	-	-	-
Chinook salmon	-	-	-
Dolly Varden	<83	83–	-
burbot	<280	280–498	>498
slimy sculpin	<51	51–68	>68

Note: A hyphen or missing value indicates that we assigned individual fish to the indicated life stage based only on examination of morphological indicators of sexual maturity, not based on fork-length threshold values.

Appendix B2.–Fish-anomaly classes.

Code	Name	Description
AB	Absent	Absent eye, fin, tail.
BK	Blackening	Tail or whole body with darkened pigmentation.
BL	Blisters	In mouth, just under skin.
BS	Extensive black spot	Small black cysts (dots) all over the fins and body.
CO	Copepod	A parasitic infection characterized by a worm-like copepod embedded in the flesh of the fish; body extends out and leaves a sore/discoloration at base, may be in mouth gills, fins, or anywhere on body.
CY	Cysts	Fluid-filled swellings; may be either small or large dots.
DE	Deformities	Skeletal anomalies of the head, spine, and body shape; amphibians may have extra tails, limbs, toes.
EF	Eroded fins	Appear as reductions or substantial fraying of fin surface area.
EG	Eroded gills	Gill filaments eroded from tip.
EX	Exophthalmia	Bulging of the eye.
FA	Fin anomalies	Abnormal thickenings or irregularities of rays
FU	Fungus	May appear as filamentous or "fuzzy" growth on the fins, eyes, or body.
GR	Grubs	White or yellow worms embedded in muscle or fins.
HM	Hemorrhaging	Red spots on mouth, body, fins, fin bases, eyes, and gills.
IC	Ich	White spots on the fins, skin or gills.
LE	Lesions	Open sores or exposed tissue; raised, granular, or warty outgrowths.
LI	Lice	Scale-like, mobile arthropods.
MU	Mucus	Thick and excessive on skin or gill, or as long cast from vent.
NO	None	No anomalies present.
OT	Other	Anomalies or parasites not specified.
SA	Scale anomalies	Missing patches, abnormal thickenings, granular skin
SO	Shortened operculum	Leaves a portion of the gill chamber uncovered
TU	Tumors	Areas of irregular cell growth which are firm and cannot be easily broken open when pinched. (Masses caused by parasites can usually be opened easily.)
WR	Leeches	Annelid worms which have anterior and posterior suckers. They may attach anywhere on the body.

Source: McCormick and Hughes 1998.

Appendix B3.–Fish-passage barrier classes.

Code	Name	Description
EBD	Ephemerally Fixed, Beaver Dam	Where the upstream movements of a given species appear, based on sufficient upstream and downstream sampling, to be blocked by a beaver dam. Used where the location of the barrier to movement is known within 100 m.
EDJ	Ephemerally Fixed, Debris Jam	Where the upstream movements of a given species appear, based on sufficient upstream and downstream sampling, to be blocked by a debris jam. This category is restricted to small scale (?10 m) features that do not dramatically alter the overall channel type. Larger mass-wasting created barriers fall in the EGD category. Used where the location of the ultimate barrier to movement is known within 100 m.
EGD	Ephemerally Fixed, Hydro-Geomorphically Dynamic	Where the upstream movements of a given species appear, based on sufficient upstream and downstream sampling, to be blocked by current hydrological or geomorphic conditions but where evidence indicates that these landscape-scale conditions are in flux over brief (decades) geologic time. Used in areas of recent or ongoing geomorphic alteration (e.g., glacial advance or retreat, mass wasting, tectonic movements, dynamic channel formation). Used where the location of the barrier to movement is within 100 m.
ELF	Ephemerally Fixed, Low Flow	Where the upstream movements of a given species appear, based on sufficient upstream and downstream sampling, to be blocked by low stream flow, but where evidence indicates that at higher stream flow, fish could ascend further up the channel. Used where the location of the barrier to movement is known within 100 m.
EOT	Ephemerally Fixed, Other	Where the upstream movements of a given species appear, based on sufficient upstream and downstream sampling, to be blocked by a non-permanent barrier other than those listed immediately above. Used where the location of the ultimate barrier to movement is known within 100 m.
ESS	Ephemerally Fixed, Spring Source	Where the upstream movements of a given species appear, based on sufficient upstream and downstream sampling or on-site analysis, to be blocked by the emergence of ground water from an unconfined substrate. Compare to GSL. Used where the location of the barrier to movement is known within 100 m.
GLK	Geologically Fixed, Lake Shore	Where the upstream movements of a given species appear, based on sufficient sampling or on-site analysis, to be limited by the perimeter of a geologically stable lake shore. Used where the location of the barrier to movement is known within 100 m.
GOT	Geologically Fixed, Other	Where the upstream movements of a given species appear, based on sufficient upstream and downstream sampling or on site analysis, to be blocked by a geologically fixed barrier other than those listed immediately above. Used where the location of the ultimate barrier to movement is known within 100 m.
GSL	Geologically Fixed, Stream Limit	Where the upstream movements of a given species appear, based on sufficient upstream and downstream sampling or on-site analysis, to be limited to the presence of surface water, and where that presence of surface water appears to be fixed in space and stable in time (compare to ELF). Spring-fed headwall pools are examples. Used where the location of the barrier to movement is known within 100 m.

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Code	Name	Description
GWG	Geologically Fixed, Waterfall/High Gradient	Where the upstream movements of a given species appear, based on sufficient upstream and downstream sampling or on-site analysis, to be blocked by a waterfall, cascade, or other similar geologically fixed barrier. Used where the location of the barrier to movement is known within 100 m.
HCU	Human, Culvert	Where the upstream movements of a given species appear, based on sufficient upstream and downstream sampling, to be blocked by a culvert through a road bed, a railroad bed, a runway, or through any other type of fill. This code includes culverts of all materials (e.g., metal, plastic, wood) and shapes (e.g., round, arched, bottomless) Used where the location of the barrier to movement is known within 100 m.
HDB	Human, Debris	Where the upstream movements of a given species appear, based on sufficient upstream and downstream sampling, to be blocked by debris placed or deposited in the stream as the direct result of human activities but where that material was not intentionally placed to impound, filter, or divert stream flow. Examples include woody debris from logging activities, and debris flows from failed road prisms. Used where the location of the barrier to movement is known within 100 m.
HDM	Human, Dam	Where the upstream movements of a given species appear, based on sufficient upstream and downstream sampling, to be blocked by a dam, weir, head gate, or other cross channel structure that impounds, filters, or diverts stream flow. This code includes structures of all materials (e.g., earth, concrete, rip rap, metal, wood). Used where the location of the barrier to movement is known within 100 m.
HOT	Human, Other	Where the upstream movements of a given species appear, based on sufficient upstream and downstream sampling, to be blocked by a human-created structure other than those listed immediately above. Used where the location of the barrier to movement is known within 100 m.
NAP	Not applicable	No fish observed. See downstream stations.
NON	None	No barrier exists at survey station.
SBU	Specific Barrier Unknown	Where a given species is collected at a downstream station and not at an upstream station but where no specific barrier is known between the 2 stations. Used where the distributional limits are not known within 100 m.
UNK	Unknown	No information exists upstream of a sample station. Often where a species is collected at a station and no additional sampling or survey occurs upstream.

Source: Michael Wiedmer (retired ADF&G Habitat Biologist, personal communication, January 2010, Seattle, WA).

Appendix B4.–Water color and substrate classes.

Water-color classes.

Code	Description	Definition
CLR	Clear	Transparent water, or nearly so.
FER	Ferric	Rust- (orange) stained.
GHT	Glacial, High Turbidity	High turbidity waters (visibility ≤ 30 cm (12 in) typical of streams originating directly from glaciers (e.g., Matanuska River).
GLT	Glacial, Low Turbidity	Low turbidity waters (visibility > 30 cm) typical of systems with large lakes (settling basins) below glacial discharge (e.g., Kenai River). These waters are frequently turquoise-colored.
HUM	Humic	Tea-colored water (tannic)
MUD	Muddy	Dark water with high suspended particulate load.

Source: Michael Wiedmer (retired ADF&G Habitat Biologist, personal communication, January 2010, Seattle, WA).

Substrate classes.

Code	Name	Intermediate-axis dimensions
BED	Bedrock	> 4,096 mm. Solid rock—few or no discrete particles
BLD	Boulder	256–4,096 mm
CBL	Cobble	64–256 mm
GRV	Gravel	2–64 mm
SSC	Sand/Silt/Clay	≤ 2 mm
ORG	Organic	Incompletely decomposed organic material

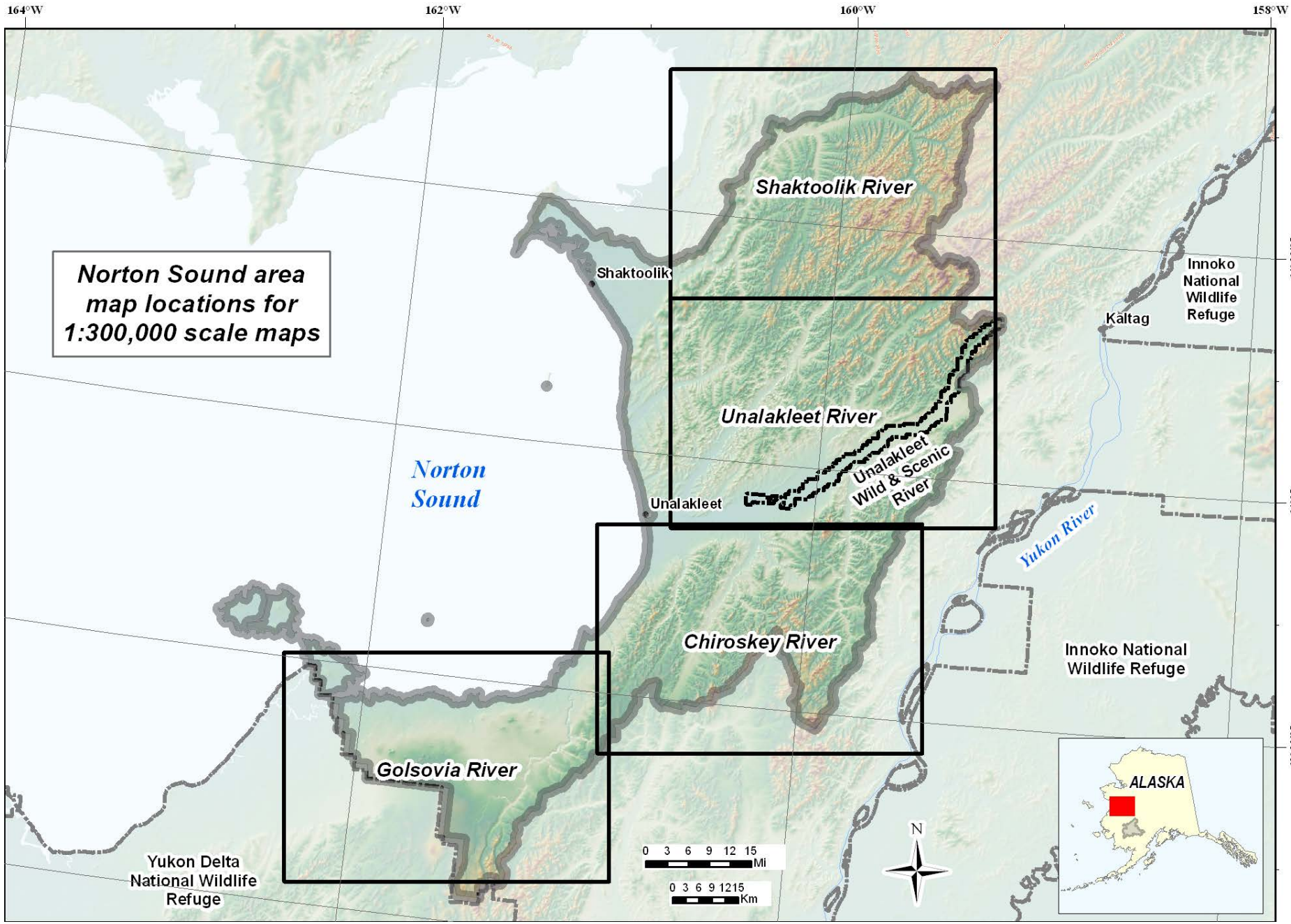
Source: adapted from Cummins (1962), which is based on the Wentworth (1922) scale. The Bedrock and Organic classes were added by Michael Wiedmer (retired ADF&G Habitat Biologist, personal communication, December 2009, Seattle, WA).

Appendix B5.–Fish species codes.

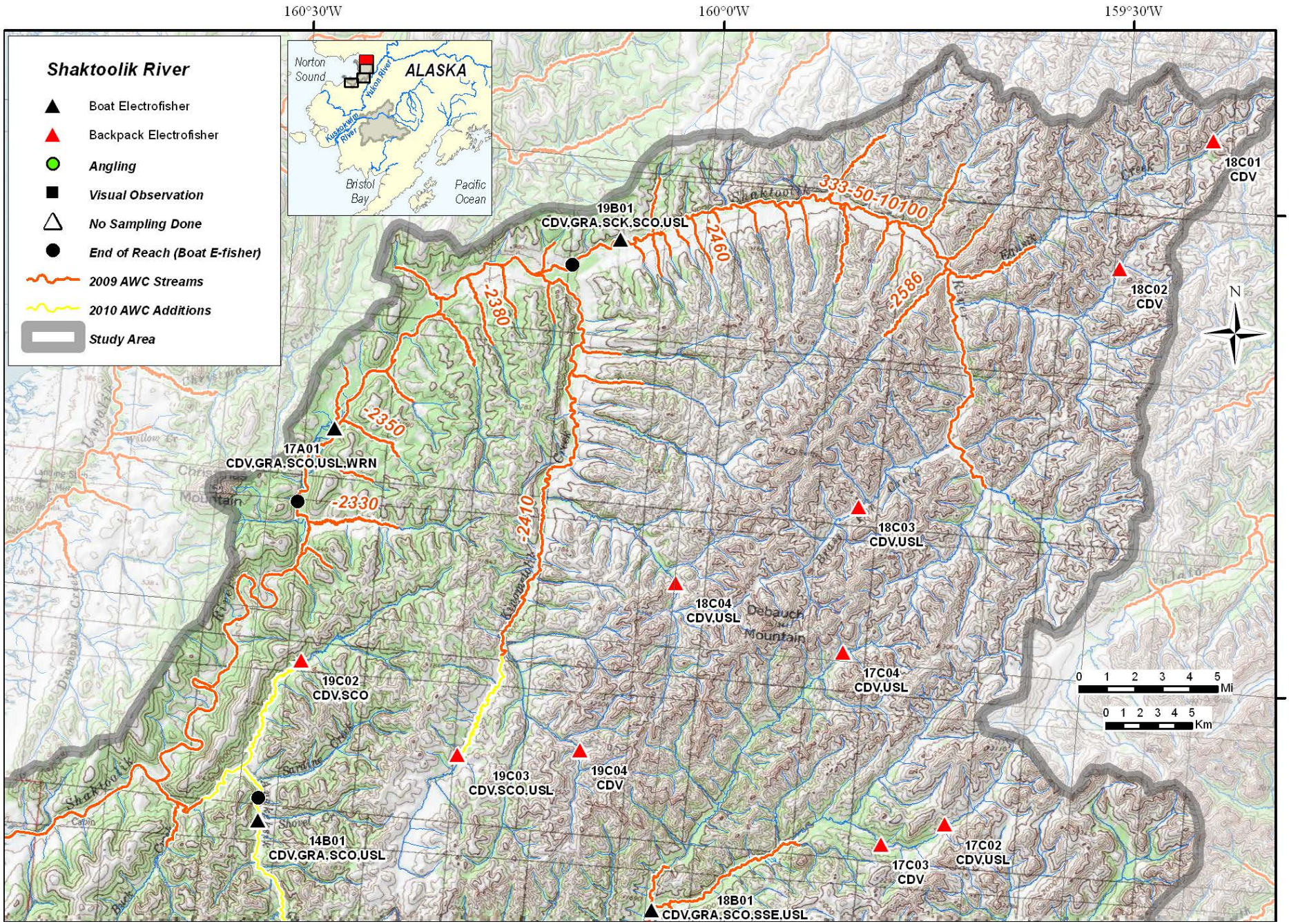
Code	Common name	Scientific name
ACI	sturgeon-unspecified	*Acipenser* sp.
ATG	green sturgeon	*Acipenser medirostris*
ATW	white sturgeon	*Acipenser transmontanus*
CAC	Arctic char	*Salvelinus alpinus*
CBT	brook trout	*Salvelinus fontinalis*
CDV	Dolly Varden	*Salvelinus malma*
CHR	char-unspecified	*Salvelinus* sp.
CLK	lake trout	*Salvelinus namaycush*
DAL	Alaska blackfish	*Dallia pectoralis*
ERC	trout-perch	*Percopsis omiscomaycus*
FAR	Arctic flounder	*Pleuronectes glacialis*
FLN	righteye flounders-unspecified	Pleuronectidae
FST	starry flounder	*Platichthys stellatus*
GAD	cod-unspecified	Gadidae
GAR	Arctic cod	*Boreogadus saida*
GBR	burbot	*Lota lota*
GPA	Pacific cod	*Gadus macrocephalus*
GRA	Arctic grayling	*Thymallus arcticus*
GSA	saffron cod	*Eleginus gracilis*
HAM	American shad	*Alosa sapidissima*
HER	herrings-unspecified	Clupeidae
HPA	Pacific herring	*Clupea pallasii*
IDA	salmonid, unspecified	Salmonidae
KNS	ninespine stickleback	*Pungitius pungitius*
KSB	stickleback-unspecified	Gasterosteidae
KTS	threespine stickleback	*Gasterosteus aculeatus*
LAC	Arctic-Alaskan brook lamprey paired species	*L. camtschatica / L. alaskense*
LAK	Alaskan brook lamprey	*Lampetra alaskense*
LAR	Arctic lamprey	*Lampetra camtschatica*
LMO	Atlantic salmon	*Salmo salar*
LMP	lamprey-unspecified	*Lampetra* sp.
LPC	Pacific lamprey	*Lampetra tridentata*
LRV	American river lamprey	*Lampetra ayresii*
LWB	western brook lamprey	*Lampetra richardsoni*
MIN	lake chub	*Couesius plumbeus*
NOS	longnose sucker	*Catostomus catostomus*
OEU	eulachon	*Thaleichthys pacificus*
OLS	longfin smelt	*Spirinchus thaleichthys*
OPS	pond smelt	*Hypomesus olidus*
ORM	rainbow smelt	*Osmerus mordax*
OSM	smelt-unspecified	Osmeridae
OSS	surf smelt	*Hypomesus pretiosus*
PIK	northern pike	*Esox lucius*
SAM	Pacific salmon-unspecified	semelparous *Oncorhynchus sp.*
SCK	Chinook salmon	*Oncorhynchus tshawytscha*
SCM	chum salmon	*Oncorhynchus keta*
SCO	coho salmon	*Oncorhynchus kisutch*
SPI	pink salmon	*Oncorhynchus gorbuscha*
SSE	sockeye salmon	*Oncorhynchus nerka*
TCT	cutthroat trout	*Oncorhynchus clarkii*
TRB	rainbow trout	*Oncorhynchus mykiss*
TRT	trout-unspecified	iteroparous *Oncorhynchus sp.*
UCR	coastrange sculpin	*Cottus aleuticus*
UFH	fourhorn sculpin	*Myoxocephalus quadricornis*
ULP	sculpin-unspecified	Cottidae
UPR	prickly sculpin	*Cottus asper*
UPS	Pacific staghorn sculpin	*Leptocottus armatus*
USH	sharpnose sculpin	*Clinocottus acuticeps*
USL	slimy sculpin	*Cottus cognatus*
WAK	Alaska whitefish	*Coregonus nelsonii*
WAR	Arctic cisco	*Coregonus autumnalis*
WBC	Bering cisco	*Coregonus laurettae*
WBD	broad whitefish	*Coregonus nasus*
WHB	humpback whitefish	*Coregonus pidschian*
WHC	humpback whitefish complex	*C. clupeaformis/C. nelsonii/C. pidschian*
WHF	whitefish-unspecified	Coregoninae
WIN	inconnu (sheefish)	*Stenodus leucichthys*
WLC	least cisco	*Coregonus sardinella*
WLK	lake whitefish	*Coregonus clupeaformis*
WPG	pygmy whitefish	*Prosopium coulteri*
WRN	round whitefish	*Prosopium cylindraceum*
YMA	shiner perch	*Cymatogaster aggregata*
YYP	yellow perch	*Perca flavescens*
QQQ	other species not listed	-
VVV	no collection effort	-
XXX	no fish collected or observed	-
ZZZ	general fish observation, no species information	-

Source: Michael Wiedmer (retired ADF&G Habitat Biologist, personal communication, June 2010, Seattle, WA).

APPENDIX C. STUDY-SITE MAPS

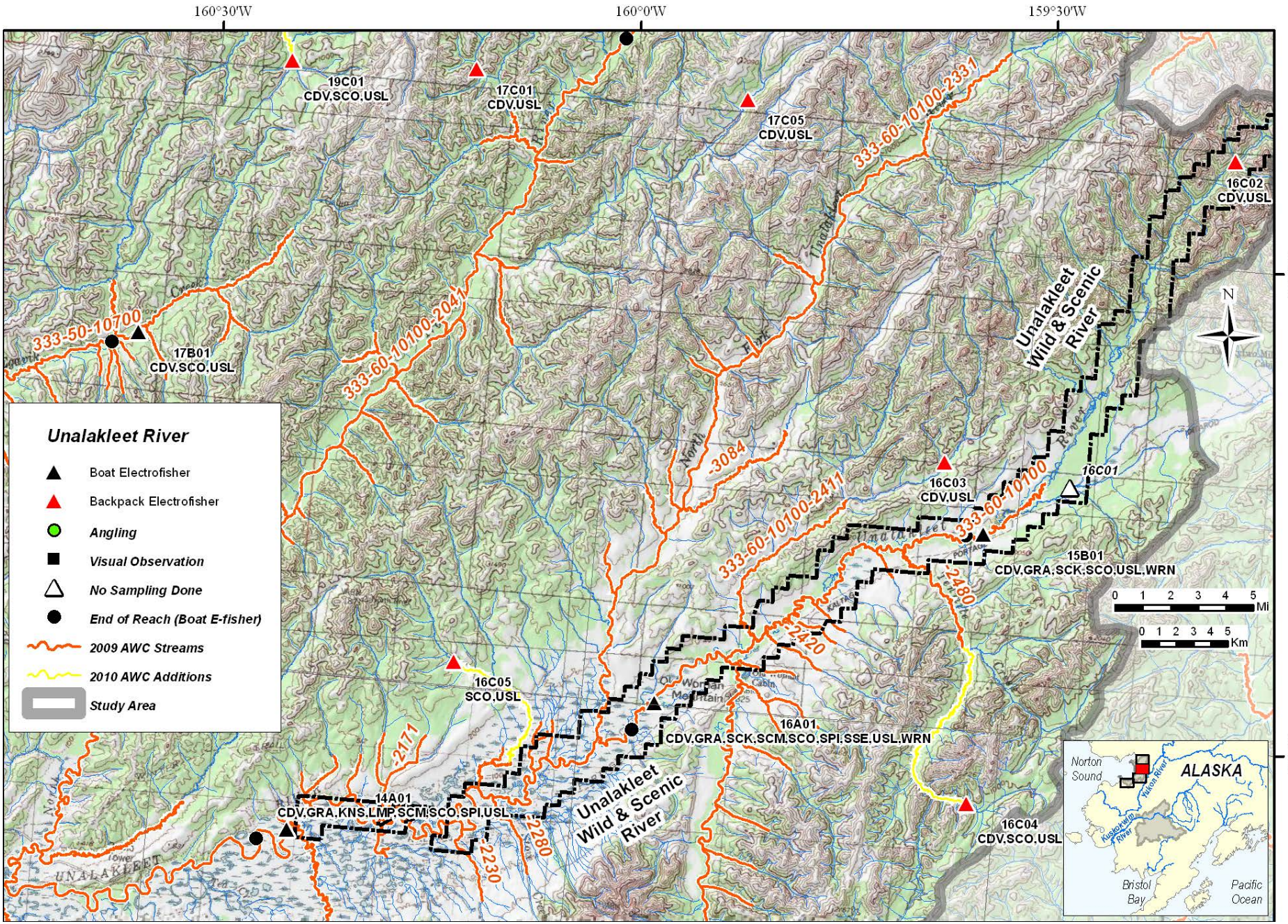


Appendix C1.–Study-site locator map.



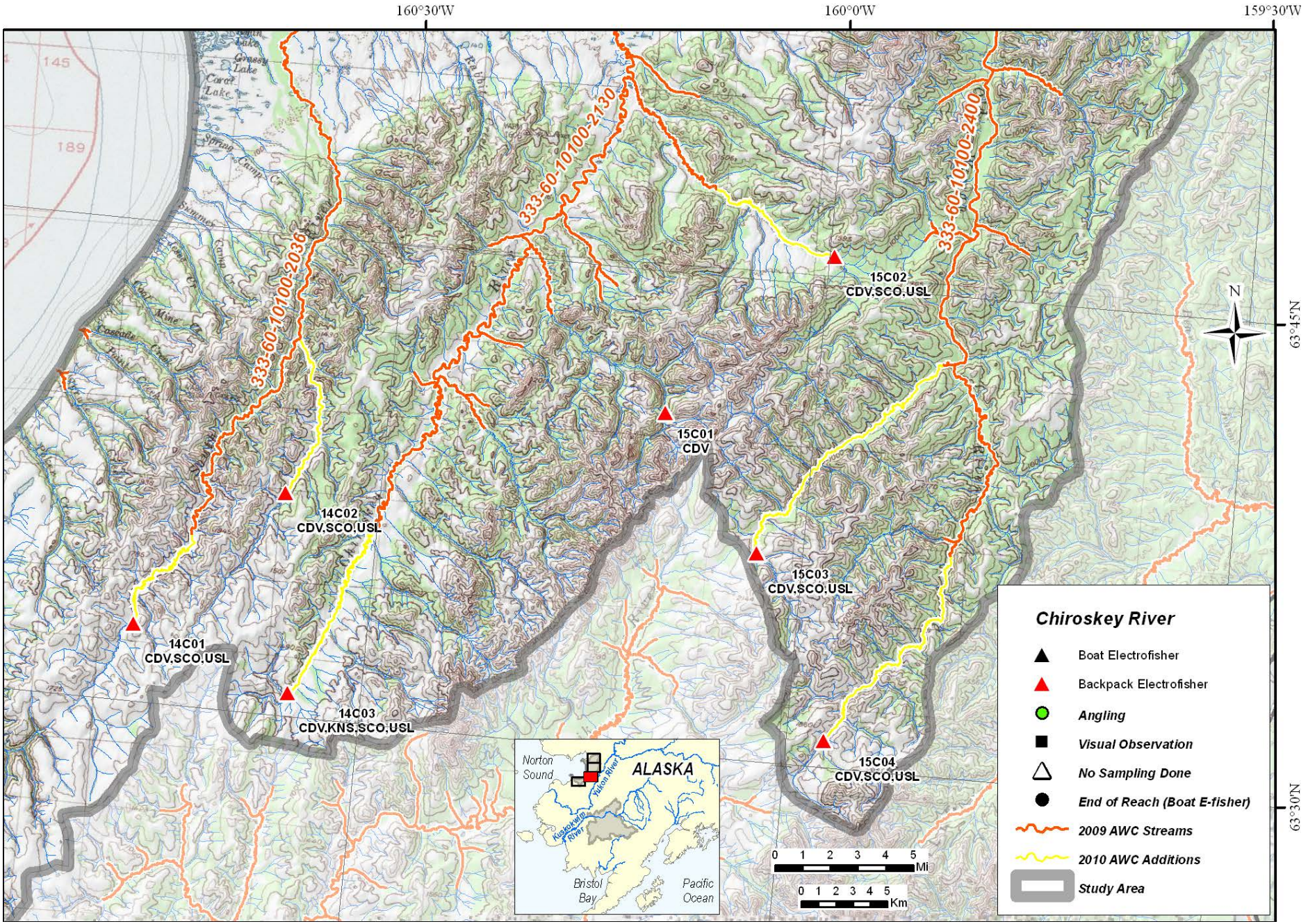
Appendix C2.–Shaktoolik River.

Note: See Appendix B5 for species names.



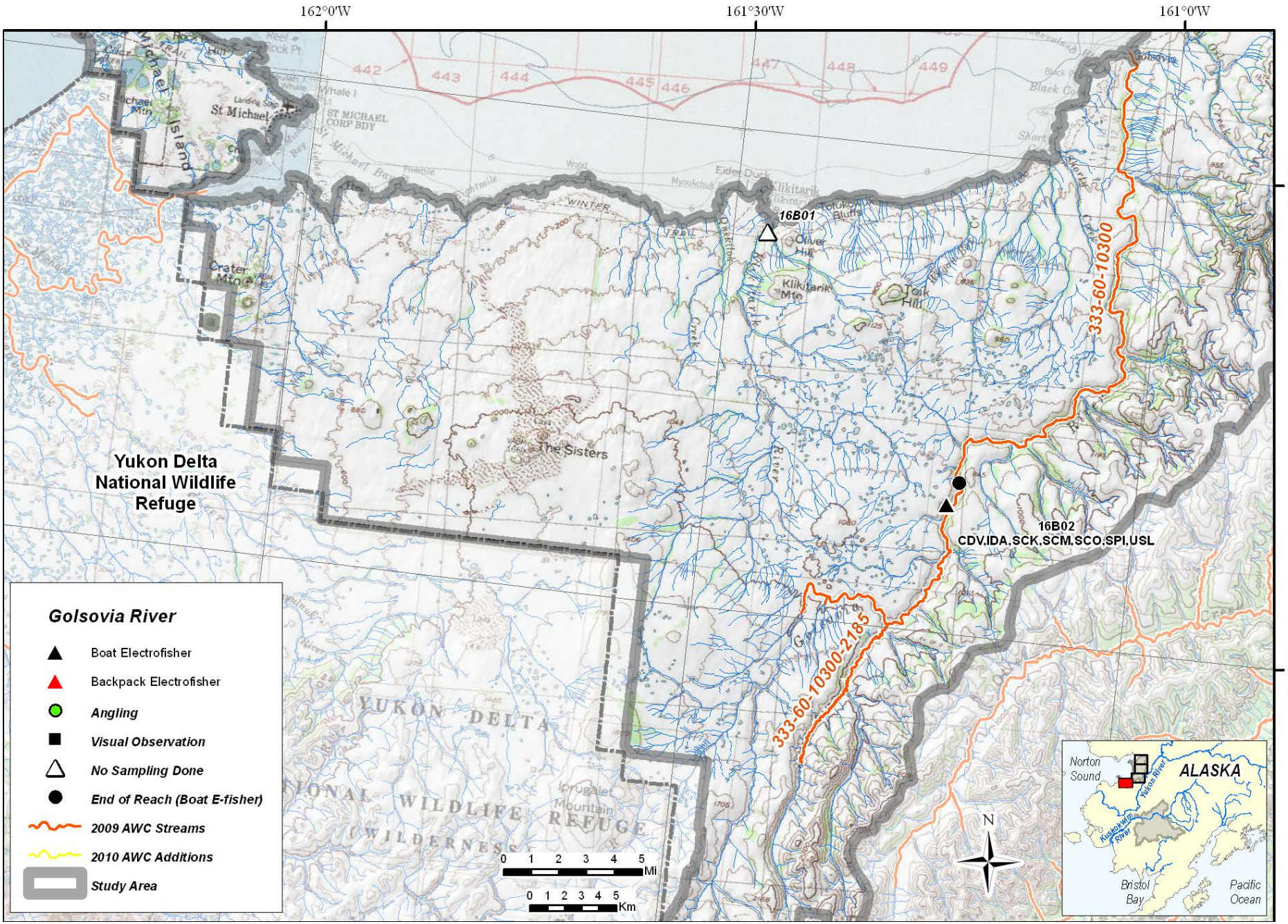
Appendix C3.–Unalakleet River.

Note: See Appendix B5 for species names.



Appendix C4.–Chiroskey River.

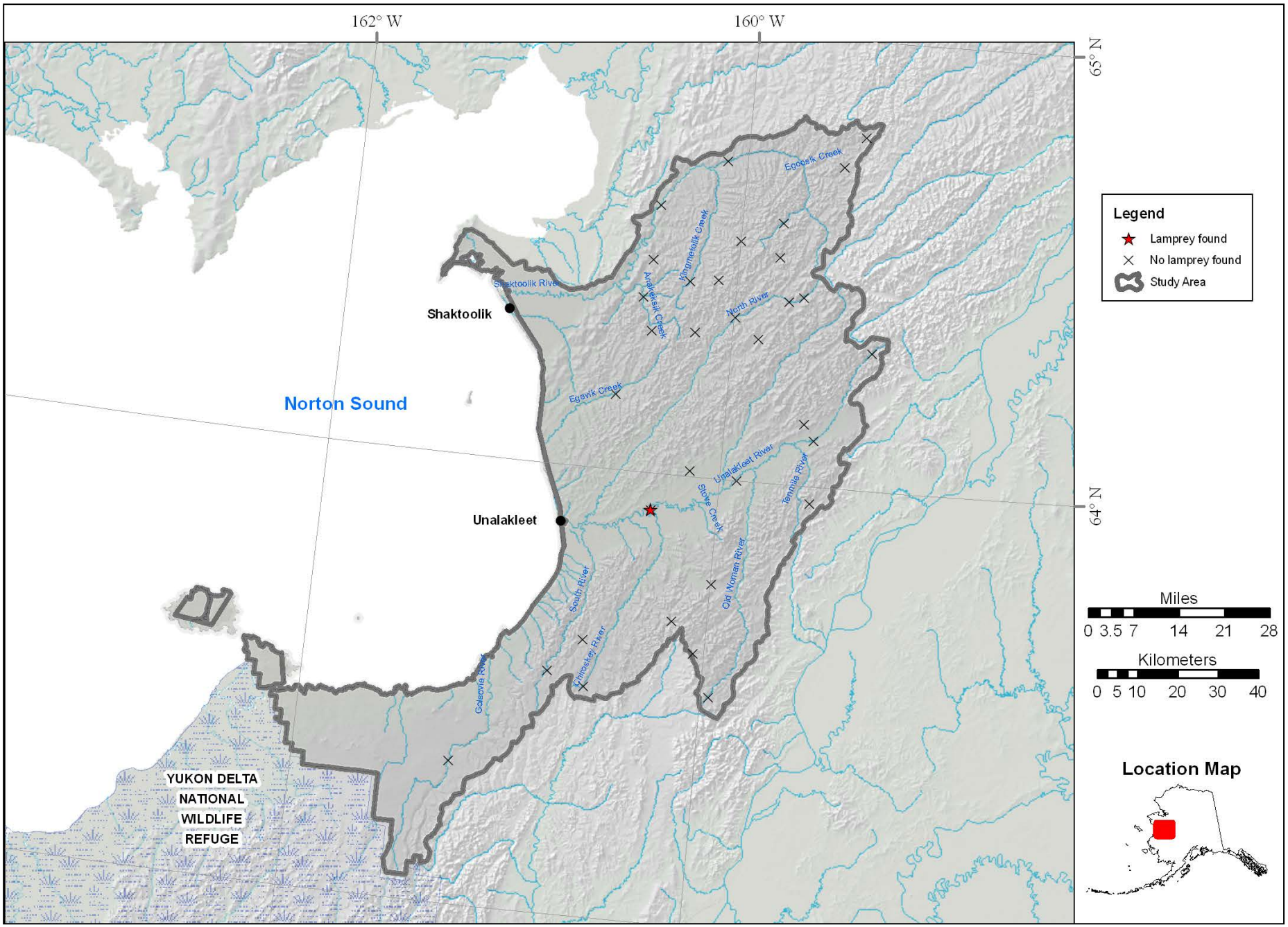
Note: See Appendix B5 for species names.



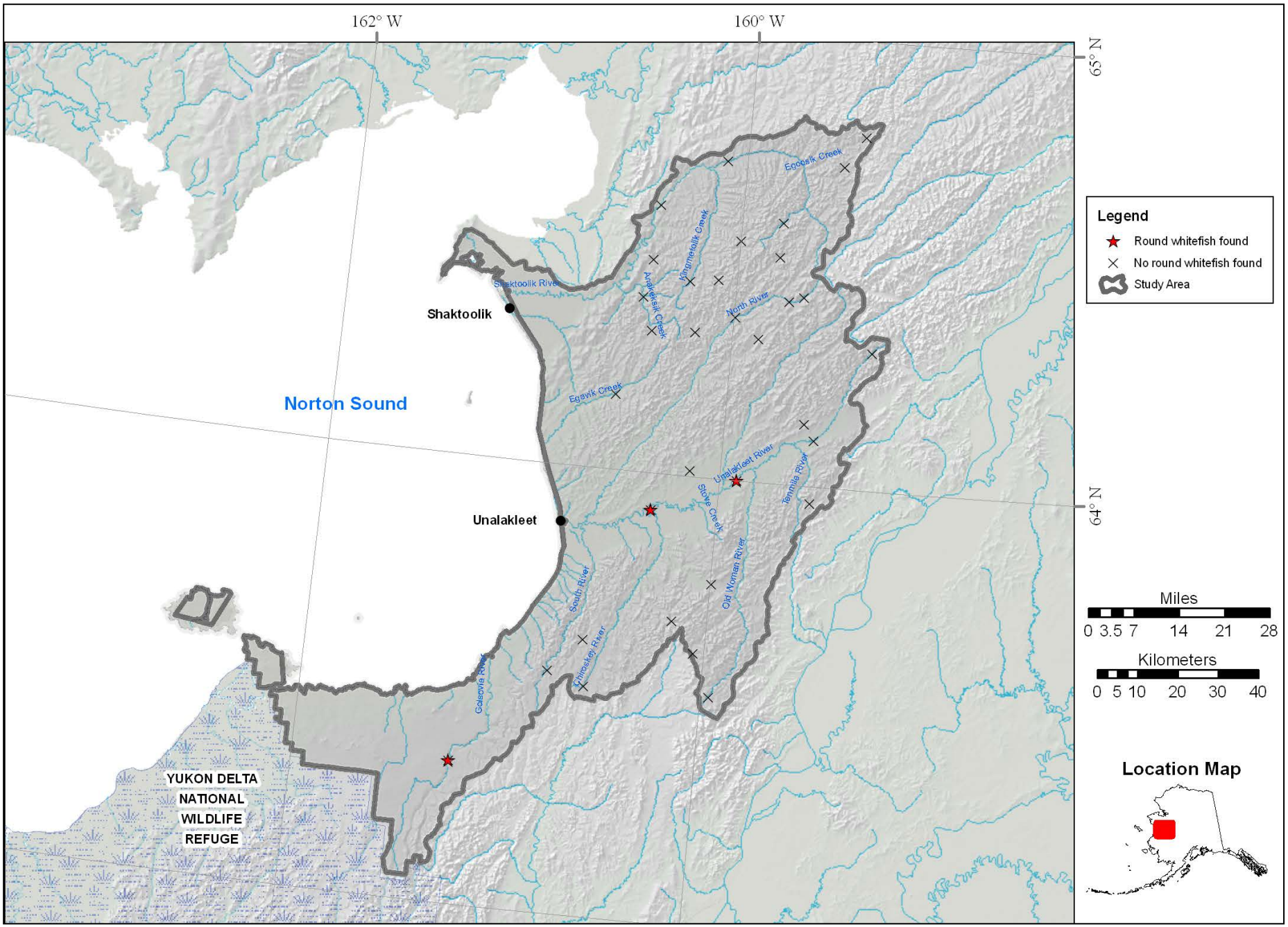
Appendix C5.–Golsovia River.

Note: See Appendix B5 for species names.

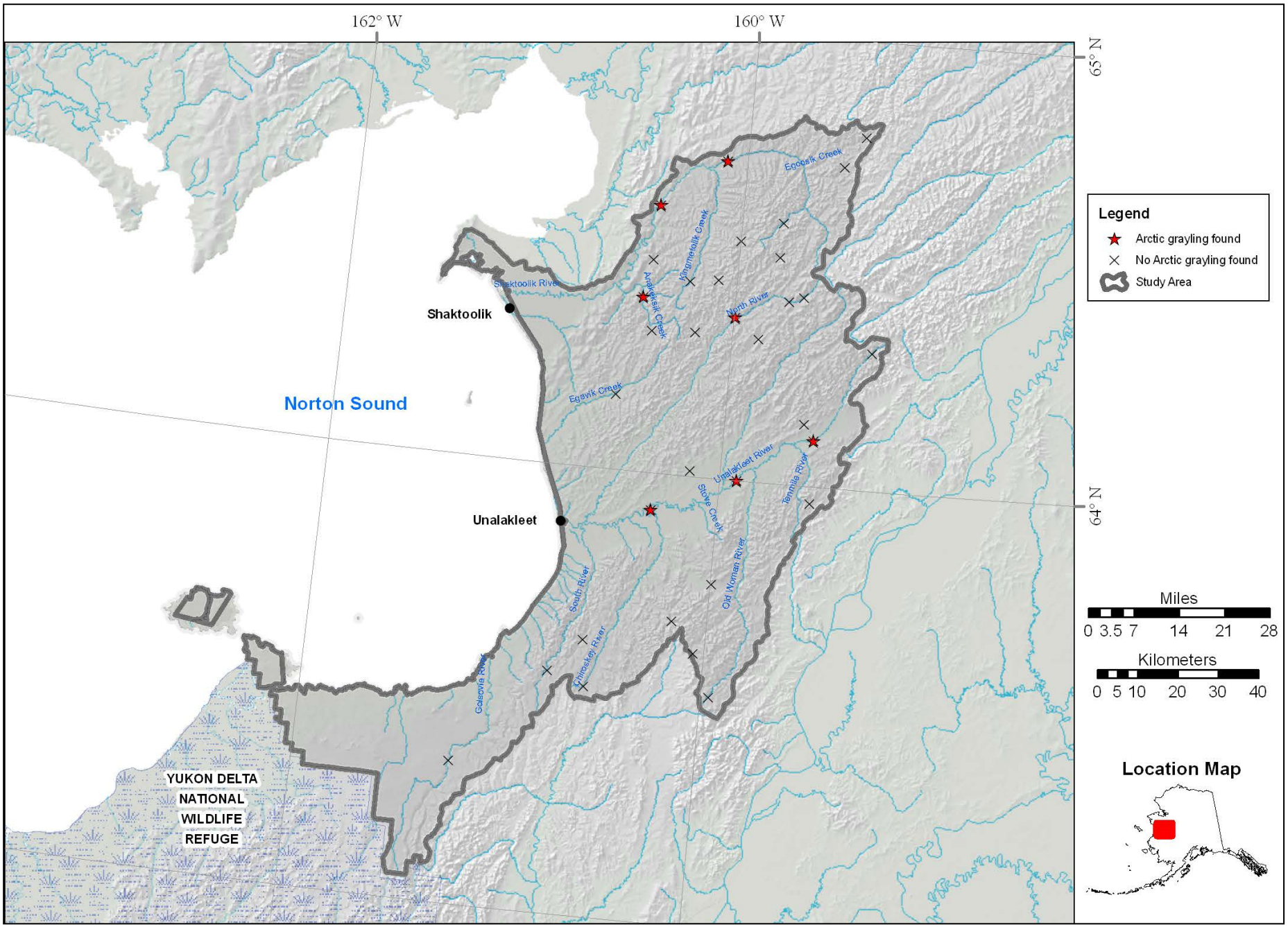
APPENDIX D. SPECIES-OCCURRENCE MAPS



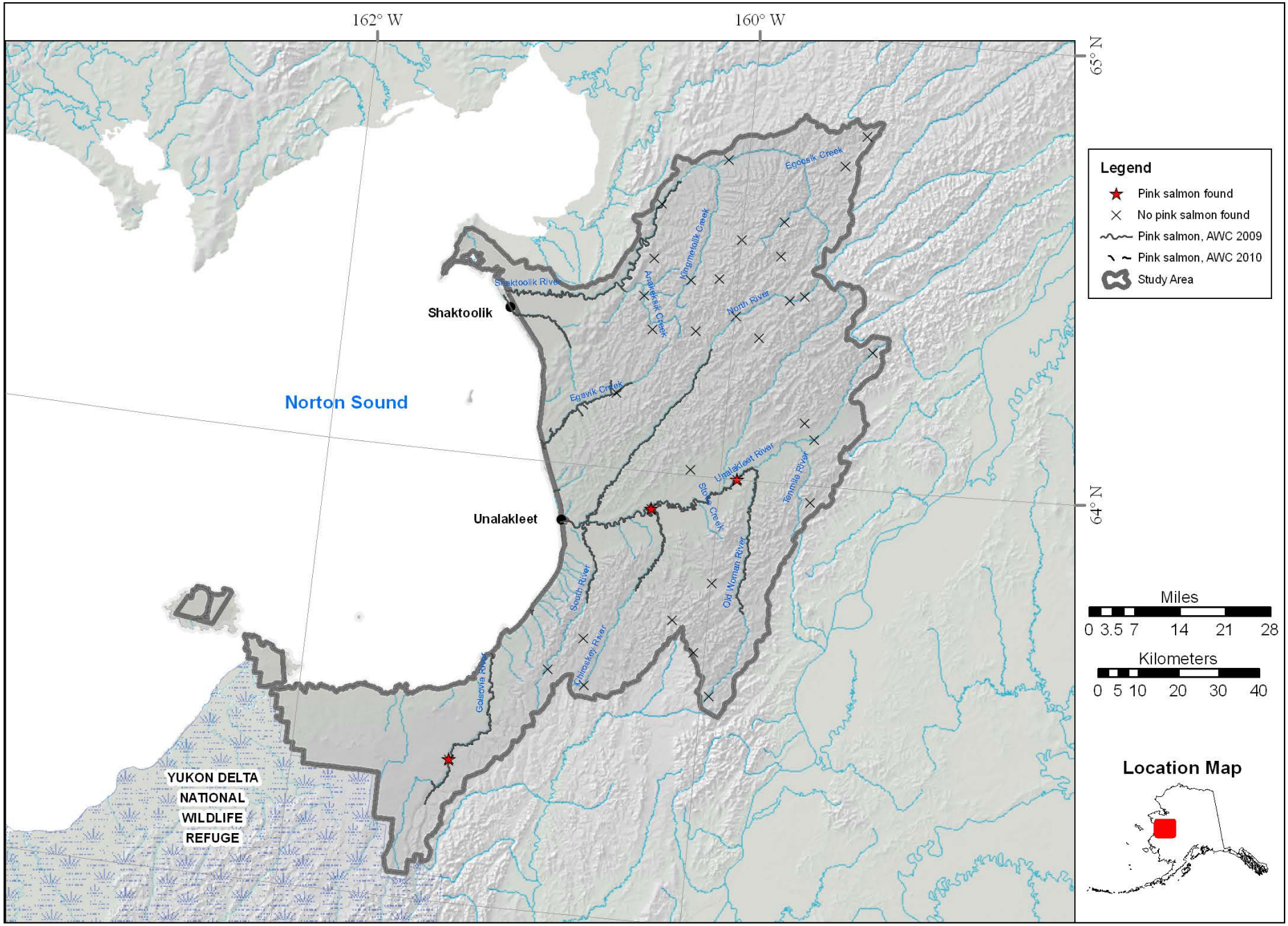
Appendix D1.–Lamprey collections.



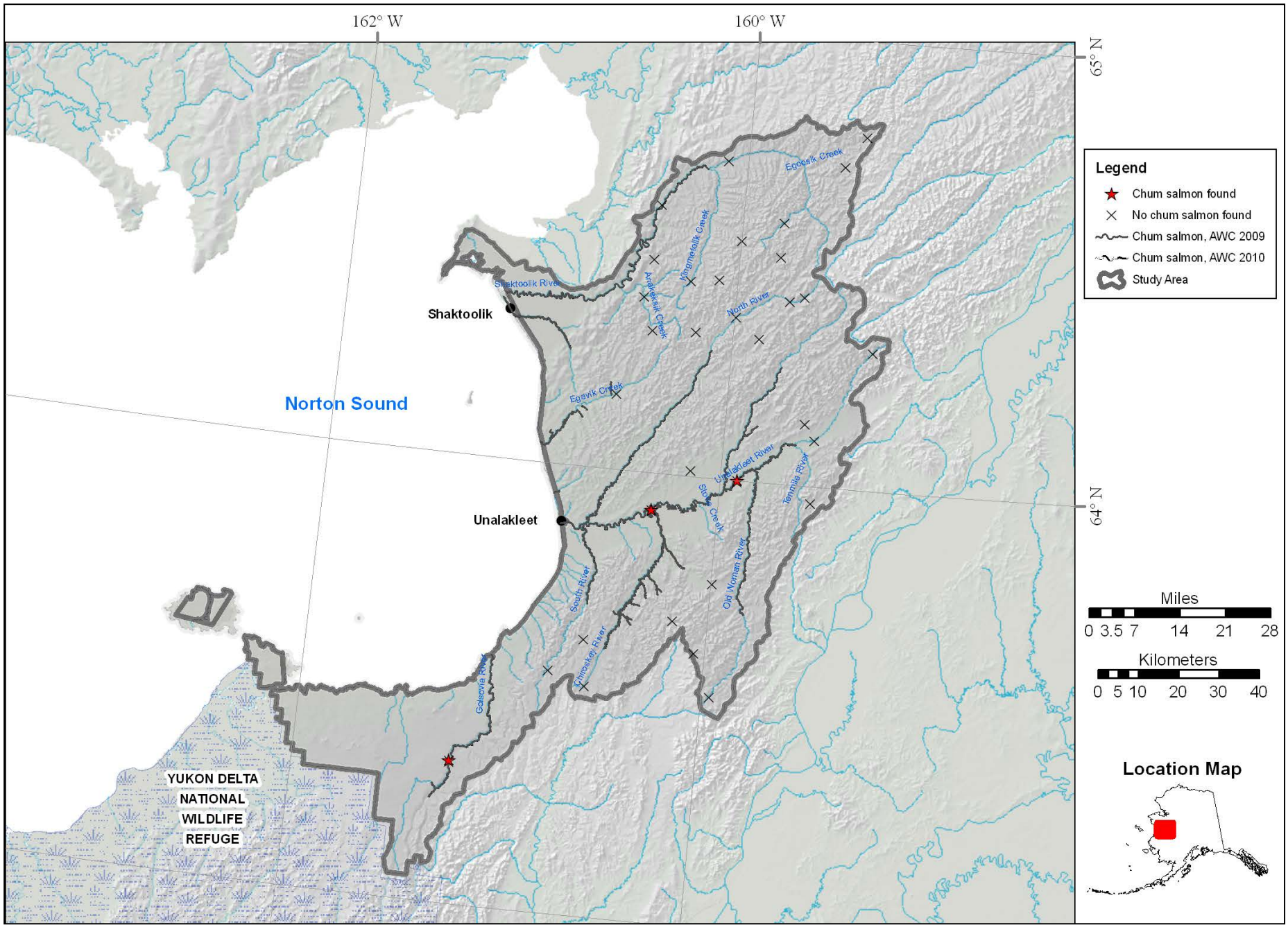
Appendix D2.–Round whitefish collections.



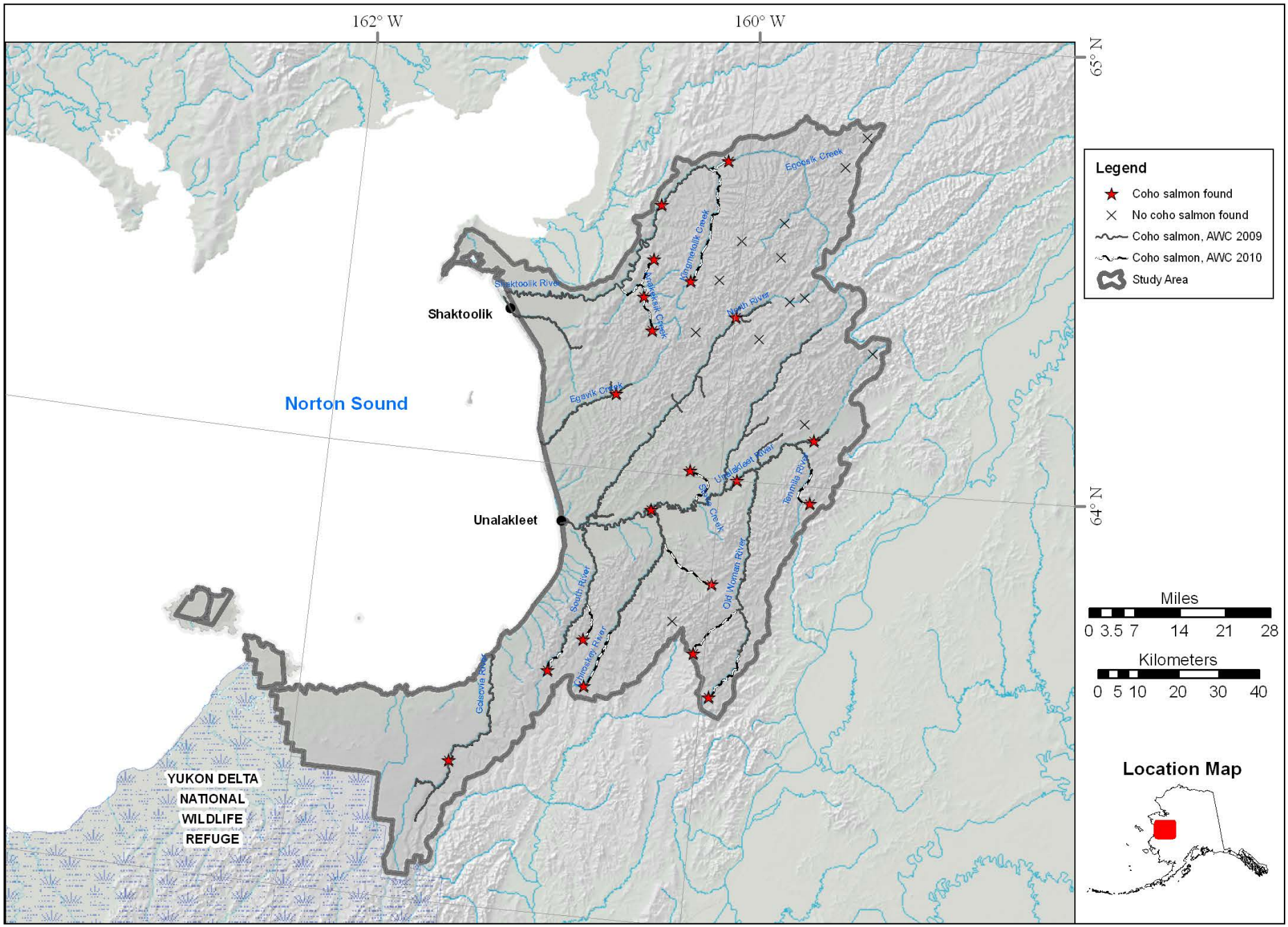
Appendix D3.–Arctic grayling collections.



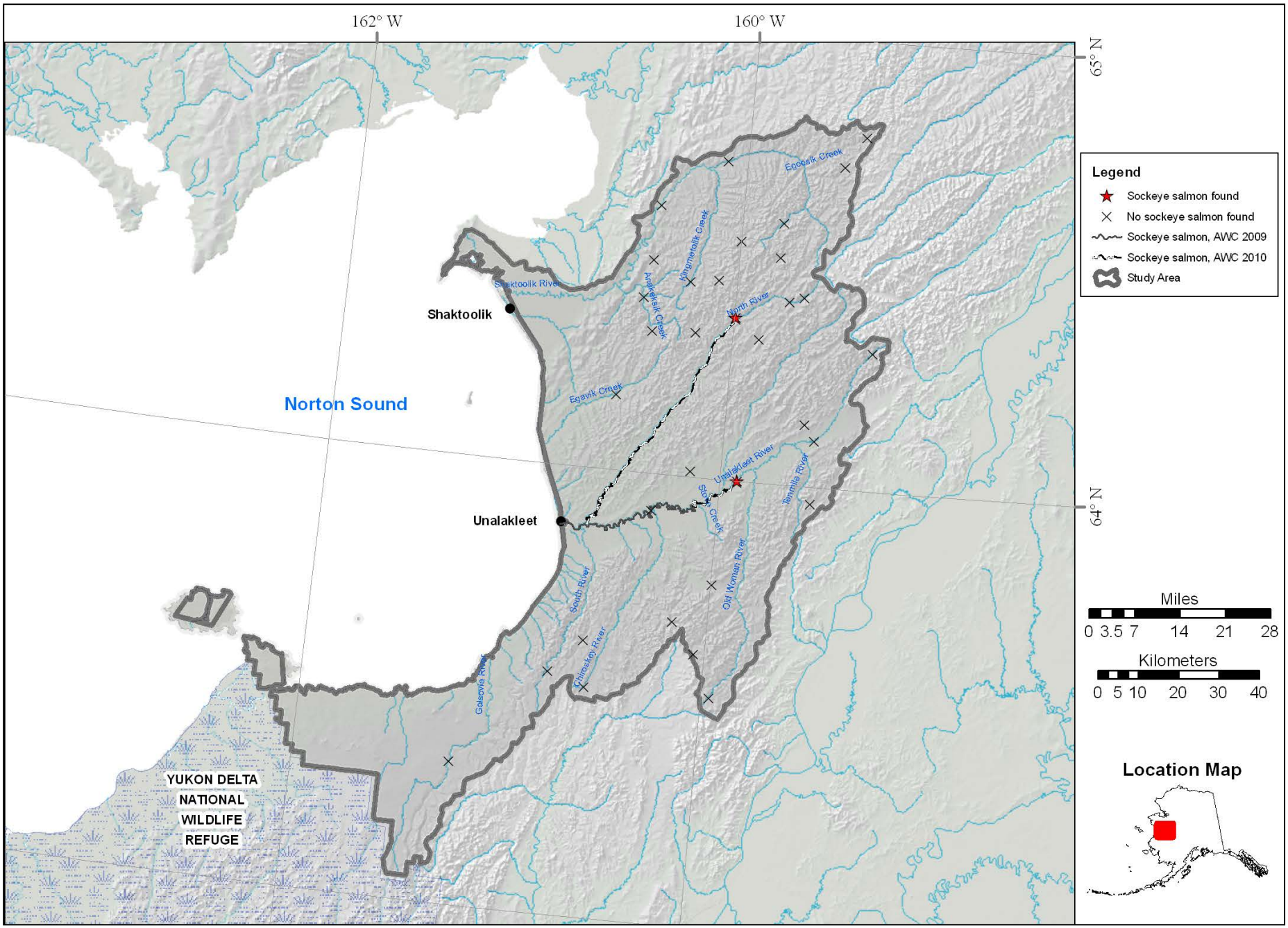
Appendix D4.–Pink salmon collections.



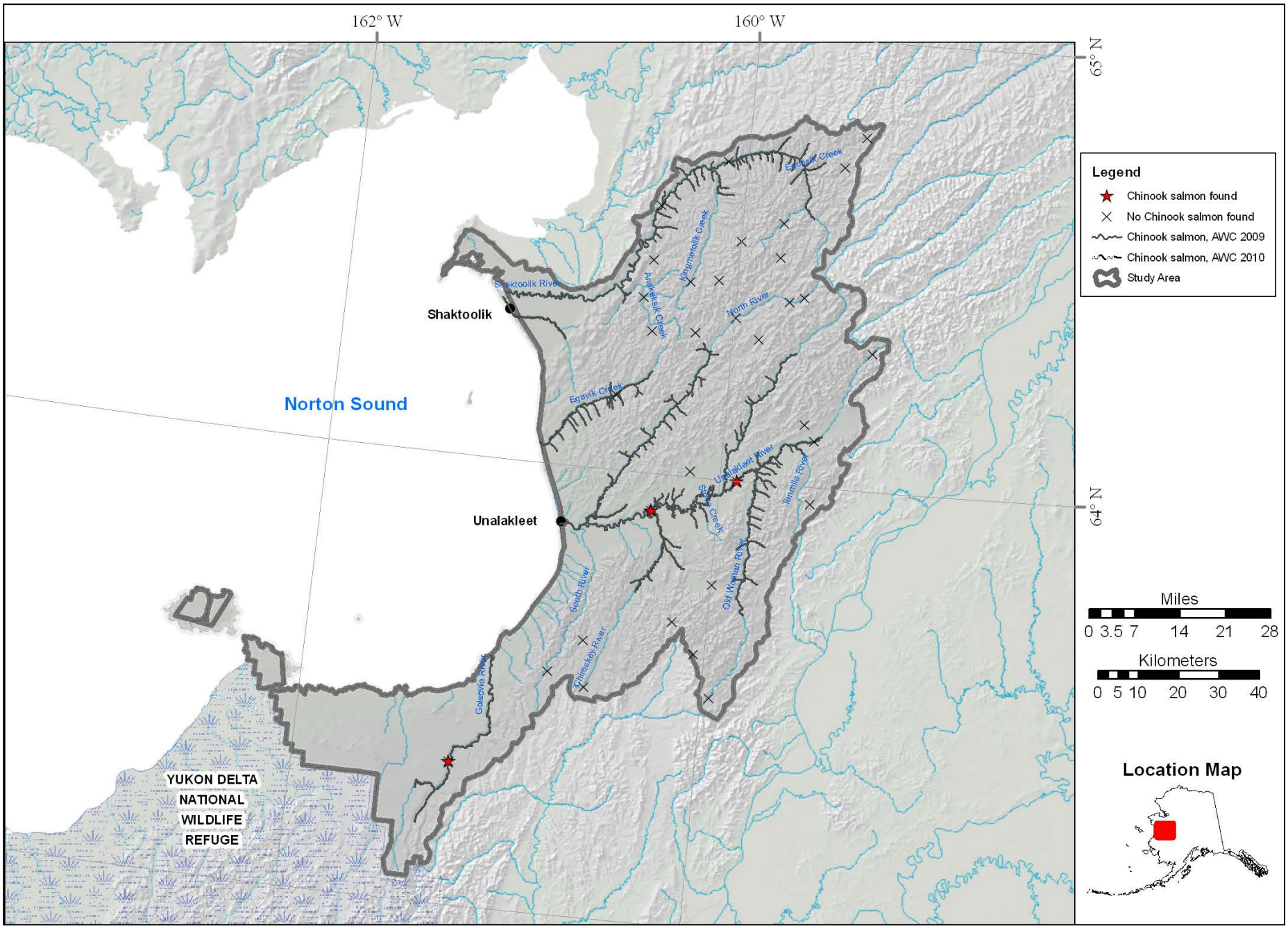
Appendix D5.–Chum salmon collections.



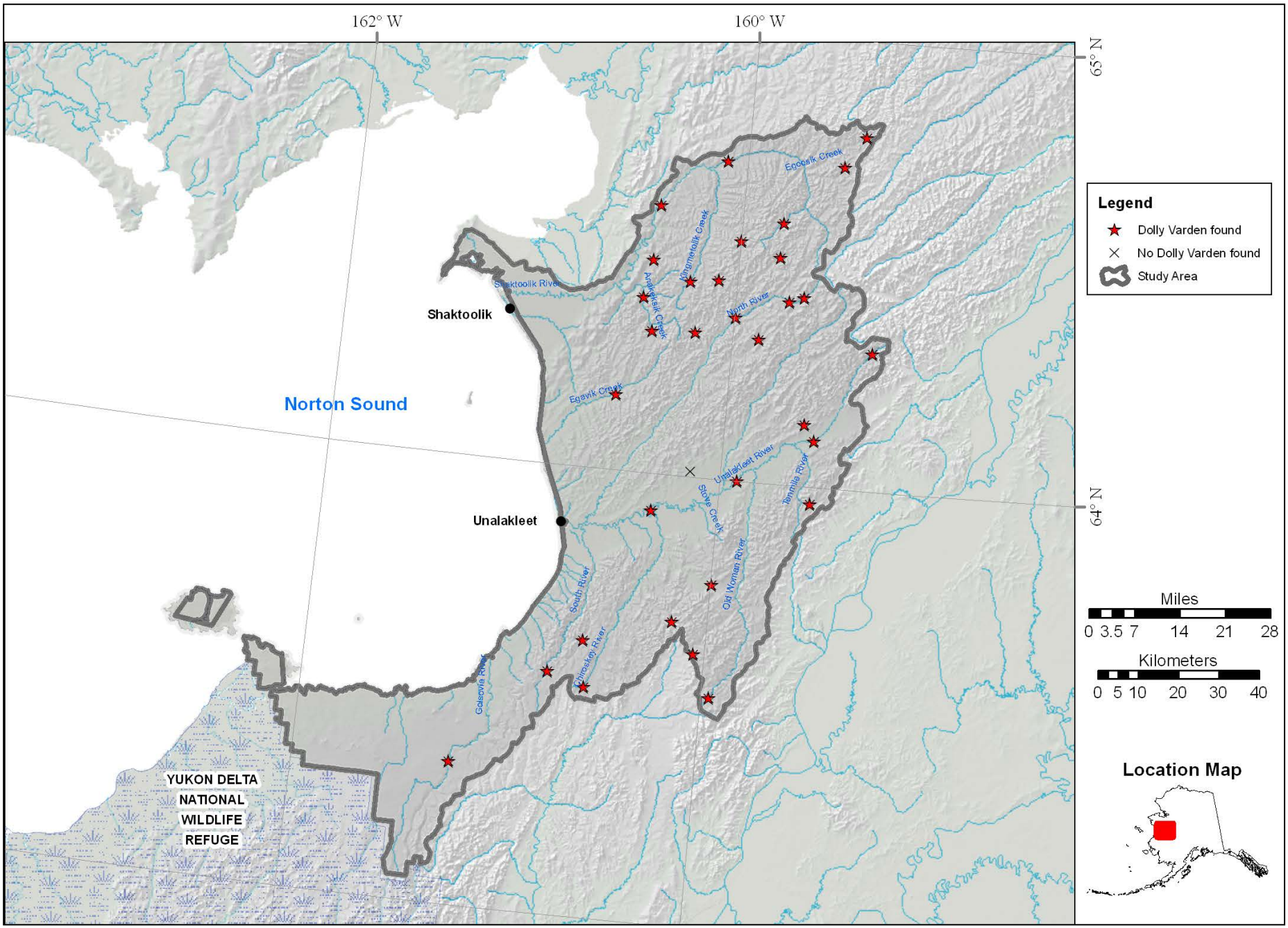
Appendix D6.–Coho salmon collections.



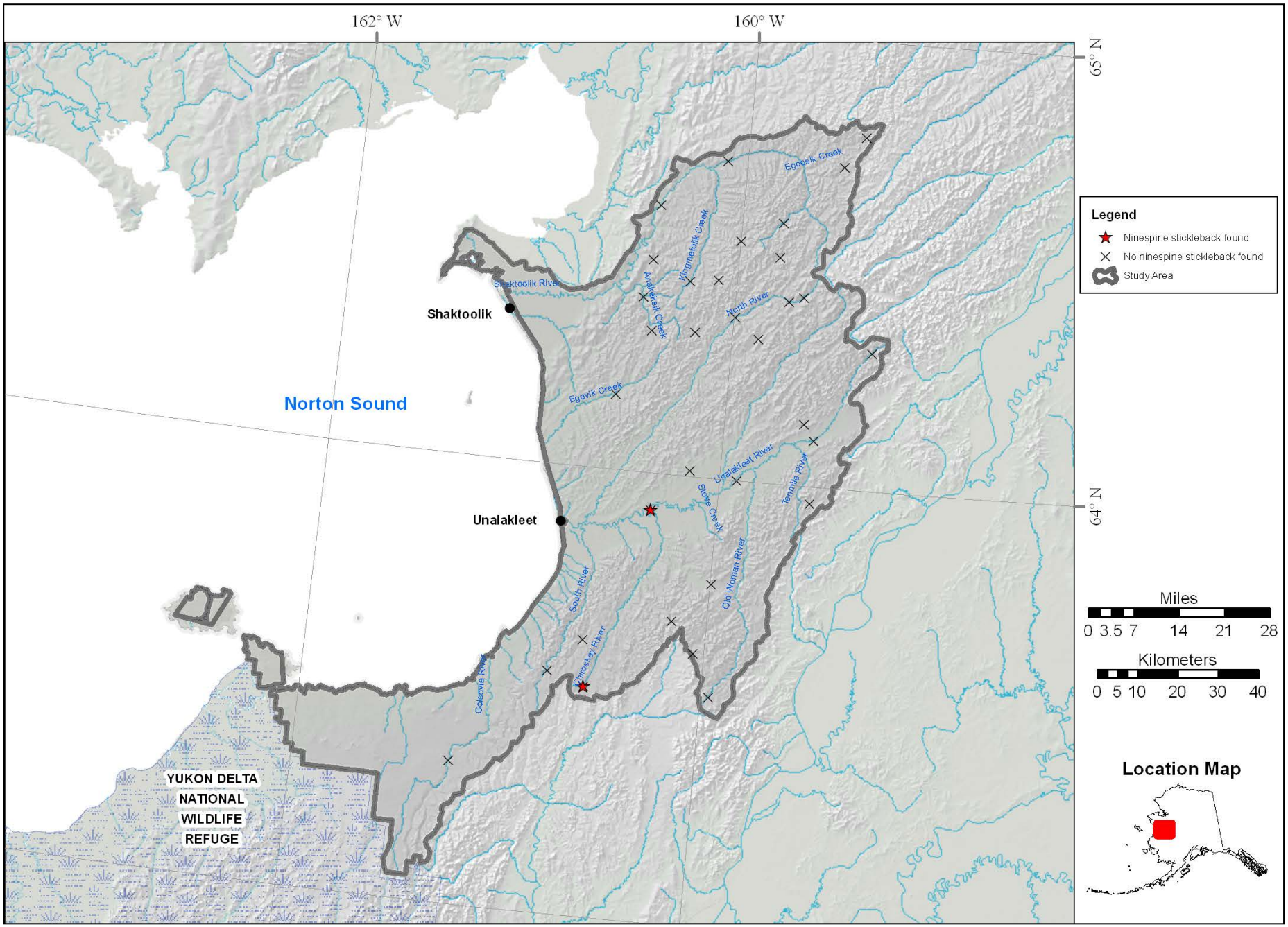
Appendix D7.–Sockeye salmon collections.



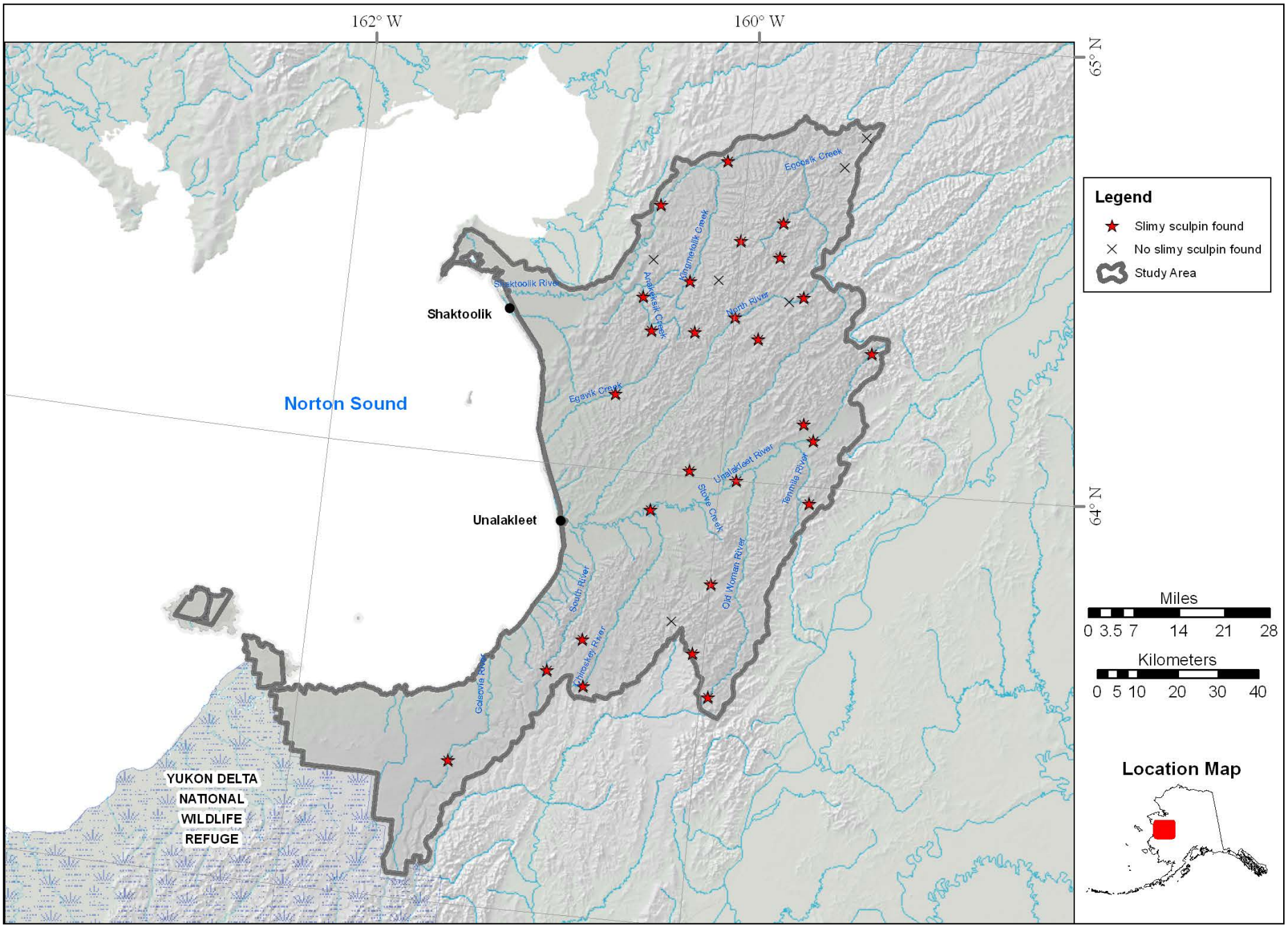
Appendix D8.–Chinook salmon collections.



Appendix D9.–Dolly Varden collections.



Appendix D10.–Ninespine stickleback collections.



Appendix D11.–Slimy sculpin collections.

APPENDIX E. SUMMARY OF ANADROMOUS WATERS CATALOG NOMINATIONS

Appendix E1.–Summary of Anadromous Waters Catalog (AWC) nominations.

Station ID	Nomination number	Stream code	Quad	Stream Name	New/Extended waterbody	New species	Backup species
14A01	09-1423	333-60-10100	Unalakleet D-3	Unalakleet River		COr	CHp, COp, Pp
14B01	09-1366	333-50-10100-2300	Norton Bay B-3	Anakeksik Creek	Y	COr	
14C01	09-1378	333-60-10100-2036	Unalakleet C-4	South River	Y	COr	
14C02	09-1379	333-60-10100-2036-3111	Unalakleet C-4	–	Y	COr	
14C03	09-1380	333-60-10100-2130	Unalakleet C-4	Chiroskey River	Y	COr	
15B01	09-1391	333-60-10100	Norton Bay A-2	Unalakleet River		COr, Kr	COp, Kp
15C02	09-1381	333-60-10100-2130-3061	Unalakleet D-2	–	Y	COr	
15C03	09-1382	333-60-10100-2400-3264	Unalakleet C-3	–	Y	COr	
15C04	09-1383	333-60-10100-2400	Unalakleet C-2	Old Woman River	Y	COr	
16A01	09-1424	333-60-10100	Norton Bay A-2	Unalakleet River		CHs, COr, Kr, Ss	COp, Pp
16B02	09-1367	333-60-10300	Unalakleet B-5	Golsovia River		COr, Kr	CHs, COp, Ps
16C04	09-1384	333-60-10100-2480	Unalakleet D-2	Tenmile River	Y	COr	
16C05	09-1385	333-60-10100-2291	Norton Bay A-3	–	Y	COr	
17A01	09-1386	333-50-10100	Norton Bay C-3	Shaktoolik River		COr	COp
17B01	09-1390	333-50-10700	Norton Bay A-4	Egavik Creek		COr	COp
18B01	09-1389	333-60-10100-2041	Norton Bay B-2	North River		Ss	COr, COs
19B01	09-1387	333-50-10100	Norton Bay C-3	Shaktoolik River		COp, COr	Kr
19C01	09-1368	333-50-10100-2300	Norton Bay B-3	–	Y	COr	
19C02	09-1369	333-50-10100-2300-3021	Norton Bay B-3	–	Y	COr	
19C03	09-1370	333-50-10100-2410	Norton Bay B-3	Kingmetolik Creek	Y	COr	

Note: AWC species/activity codes: Pp = pink salmon present; Ps = pink salmon spawning; COp = coho salmon present; COr = coho salmon rearing; Kp = Chinook salmon present; Ks = Chinook salmon spawning; Kr = Chinook salmon rearing; CHp = chum salmon present; CHs = chum salmon spawning; Sp = sockeye salmon present.

APPENDIX F. OCCURRENCE OF FISH SPECIES AND LIFE STAGES, BY STREAM SIZE

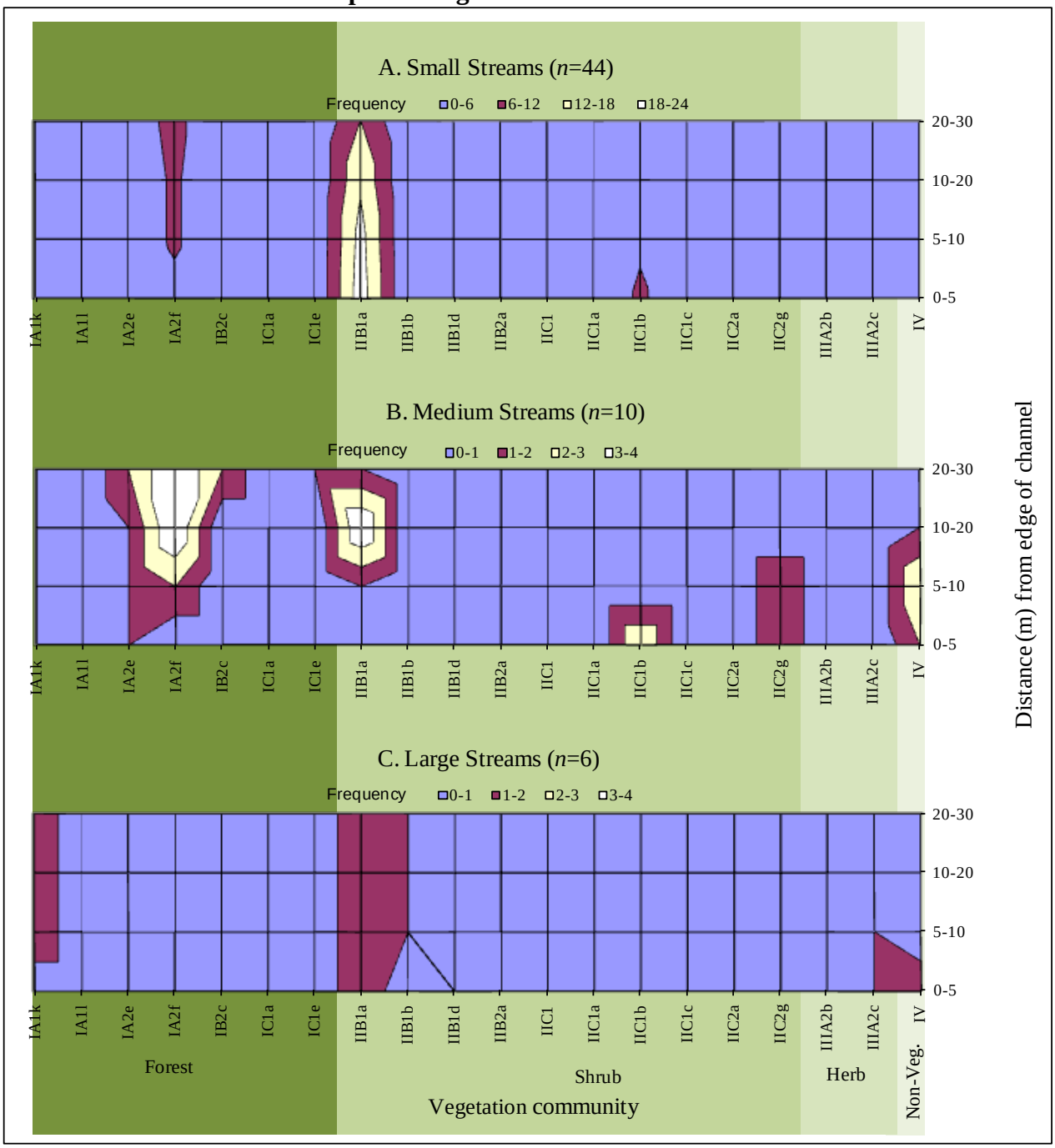
Appendix F1.–Occurrence (no. of electrofished reaches) of fish species and life stages, by stream size.

Common name	Scientific name	Life stage	Large streams (*n*=4)	Medium streams (*n*=5)	Small streams (*n*=24)	Total (*n*=33)
lamprey-unspecified	*Lampetra* sp.	juvenile	1			1
round whitefish	*Prosopium cylindraceum*	adult	2	1		3
Arctic grayling	*Thymallus arcticus*	juvenile	3			3
		juvenile/adult	1	1		2
		adult	4	3		7
pink salmon	*Oncorhynchus gorbuscha*	adult	1			1
		adult spawning		1		1
		carcass	1	1		2
chum salmon	*Oncorhynchus keta*	adult	1			1
		adult spawning	1	1		2
coho salmon	*Oncorhynchus kisutch*	juvenile	4	5	11	20
		adult	4	4		8
sockeye salmon	*Oncorhynchus nerka*	adult spawning	1	1		2
Chinook salmon	*Oncorhynchus tshawytscha*	juvenile	2	2		4
		carcass		1		1
Dolly Varden	*Salvelinus malma*	juvenile	1	5	22	28
		juvenile/adult	3	5	22	30
		adult	4	1	9	15
		adult spawning		4	1	5
ninespine stickleback	*Pungitius pungitius*	juvenile	1			1
		adult			1	1
slimy sculpin	*Cottus cognatus*	juvenile	4	5	10	19
		juvenile/adult	4	5	16	25
		adult	4	5	15	24

APPENDIX G. GRAPHICAL SUMMARIES OF FISH AND HABITAT VARIABLES.

Appendix G1.–Distributions of categorical habitat variables.

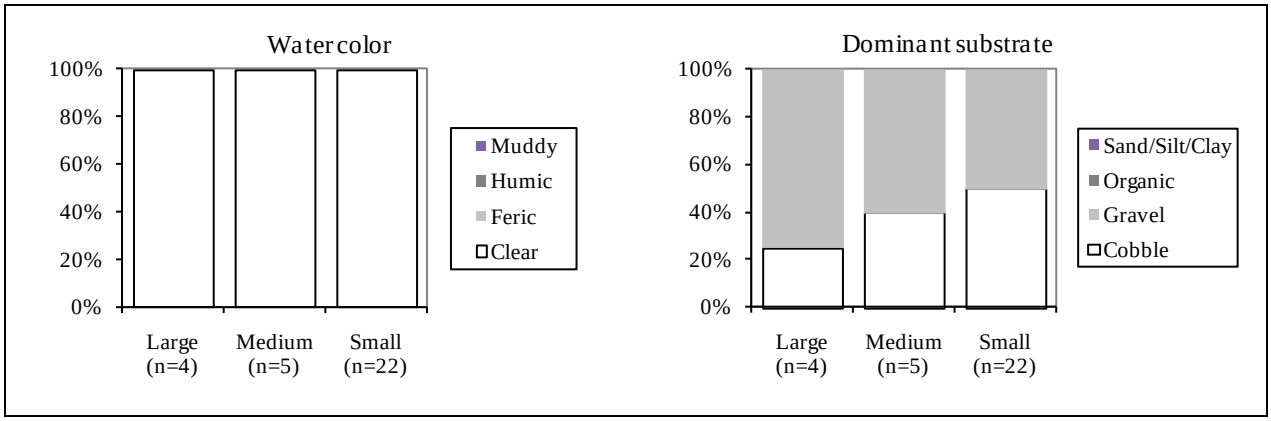
Occurrence of dominant riparian vegetation communities at fish-collection reaches.



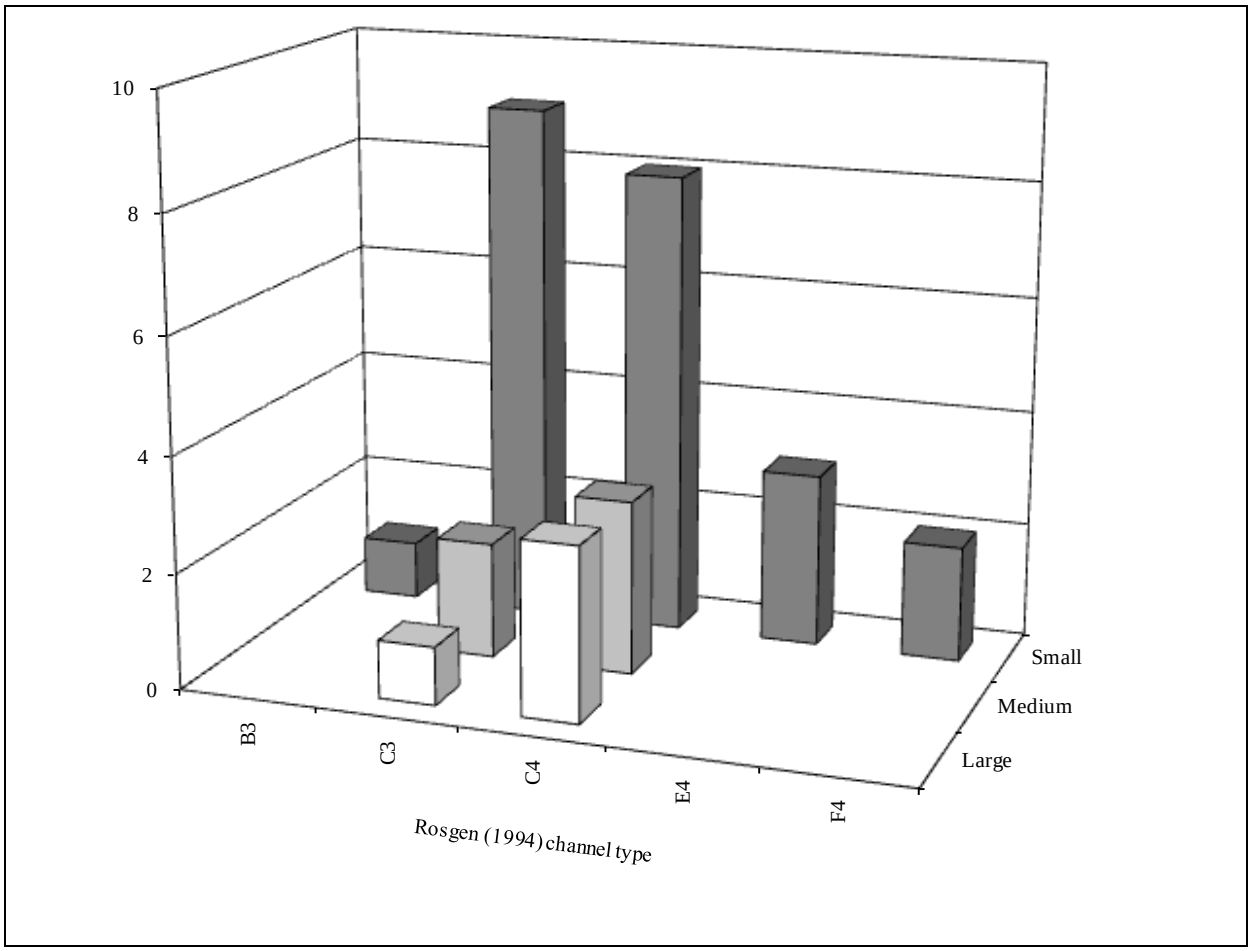
Note: Level-IV vegetation communities (Viereck et al. 1992) are shown along the X-axis. Along the Y-axis, vegetation communities are grouped into 4 zones according to their distance (m) from the edge the of the stream channel (OHW mark). The count of each vegetation community type is represented by shading. Vegetation communities along both stream banks are included—so, for each fish-collection reach, there are 2 vegetation community counts per zone.

-continued-

Occurrence of water-color, dominant-substrate, and Rosgen channel types at fish-collection reaches

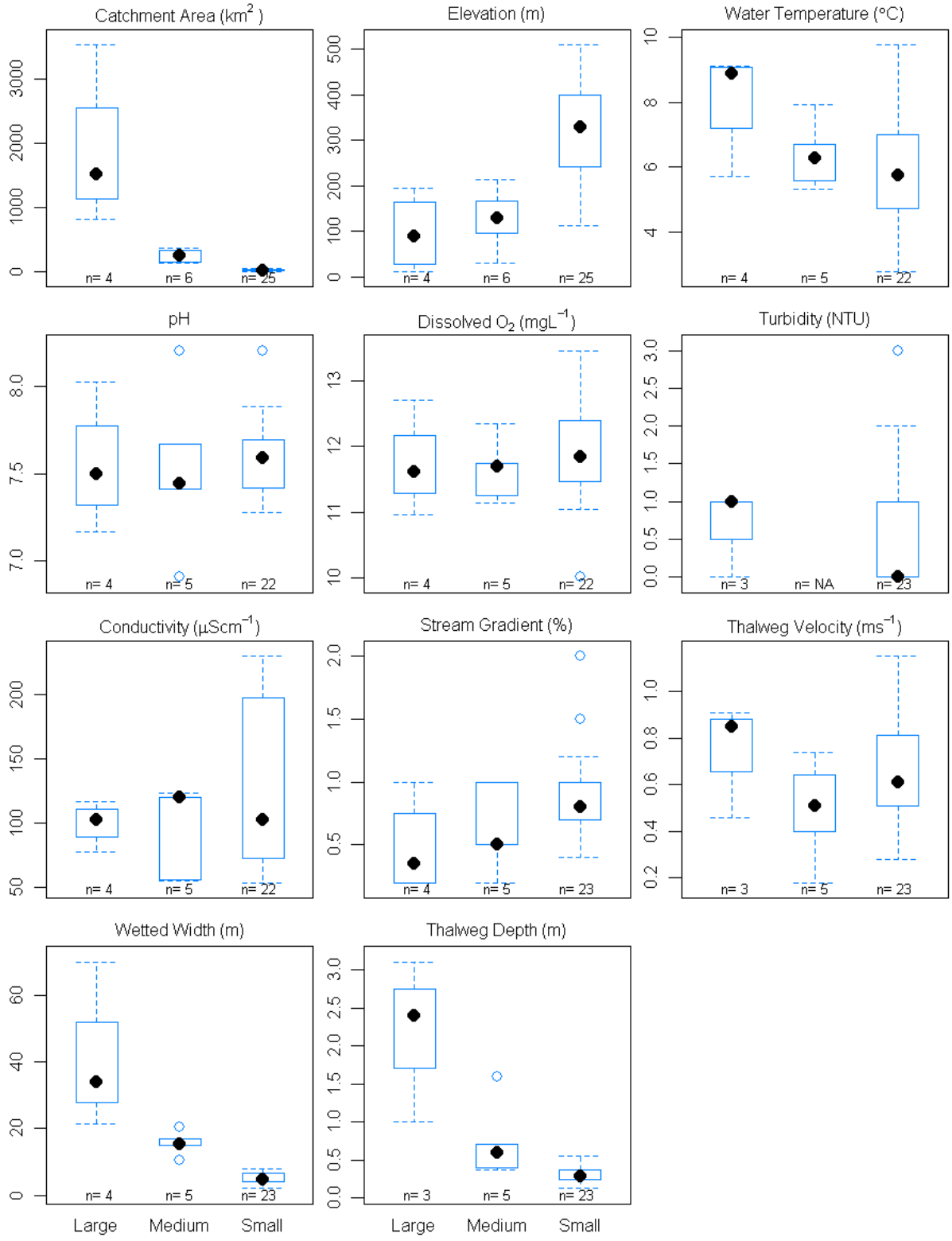


Note: Variables are grouped along the X-axis by stream-size.



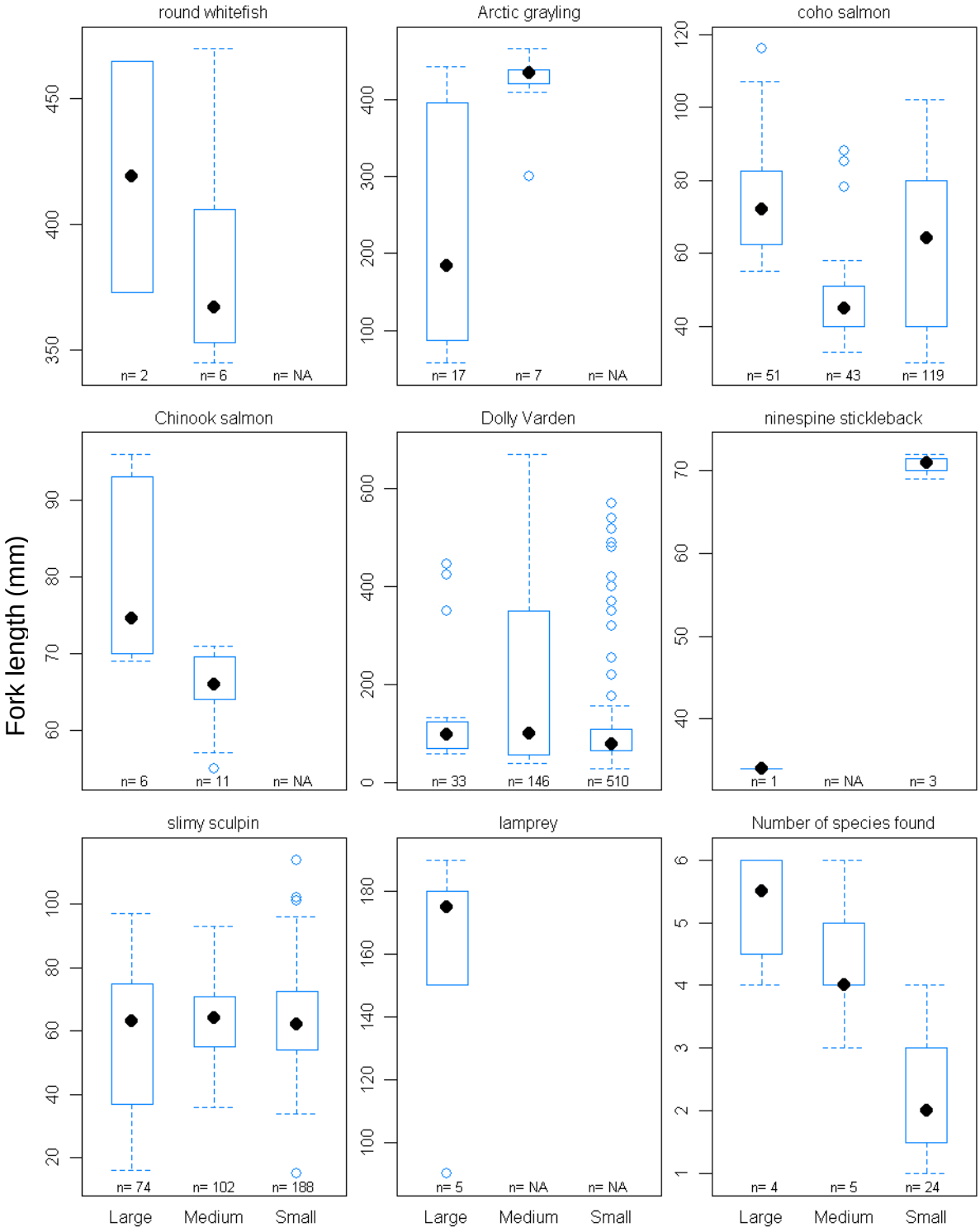
Note: Level-II Rosgen (1994) channel type (X-axis) of fish-collection reaches, grouped by stream size (Y-axis). Bar height (Z-axis) represents the count of fish-collection reaches.

Appendix G2.–Box plots of selected numeric habitat variable distributions, grouped by stream size.



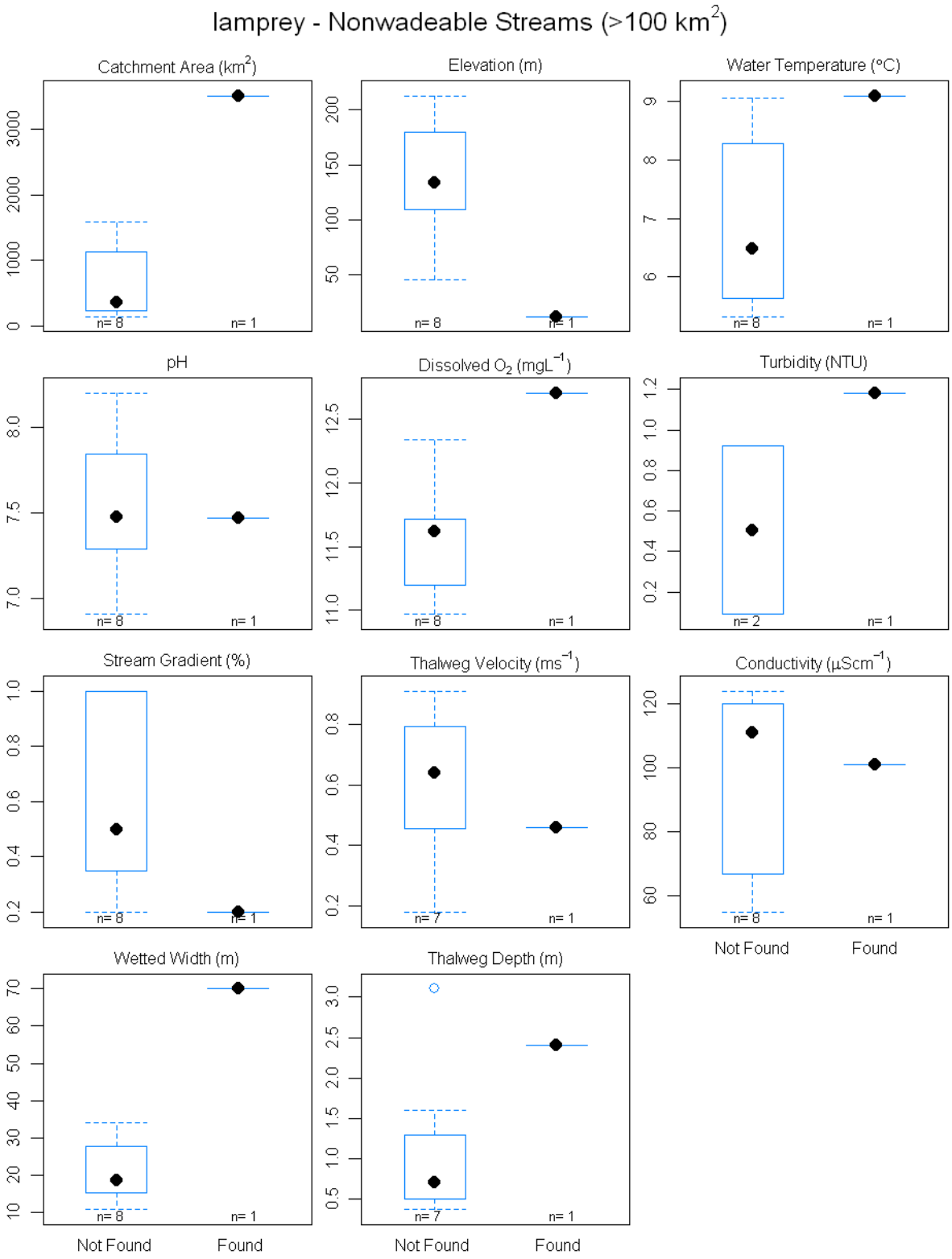
Note: Stream-size categories are based on drainage area (sq. km) upstream of each station (i.e., catchment area). Small streams, < 100 sq. km; Medium streams, 100–500 sq. km; Large streams, > 500 sq. km.

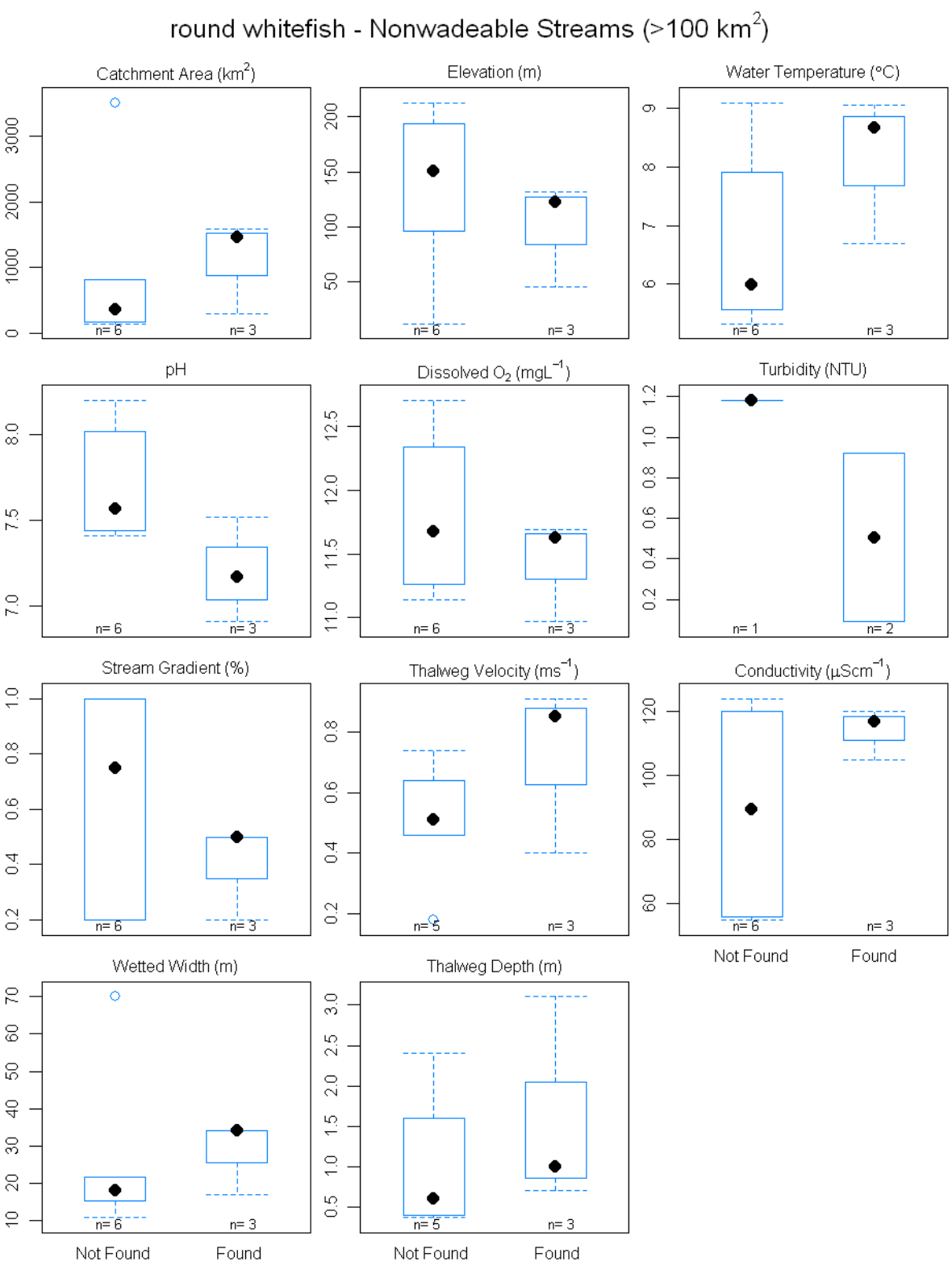
Appendix G3.–Box plots of fork lengths of selected fish species, and the number of species found per site, grouped by stream size.

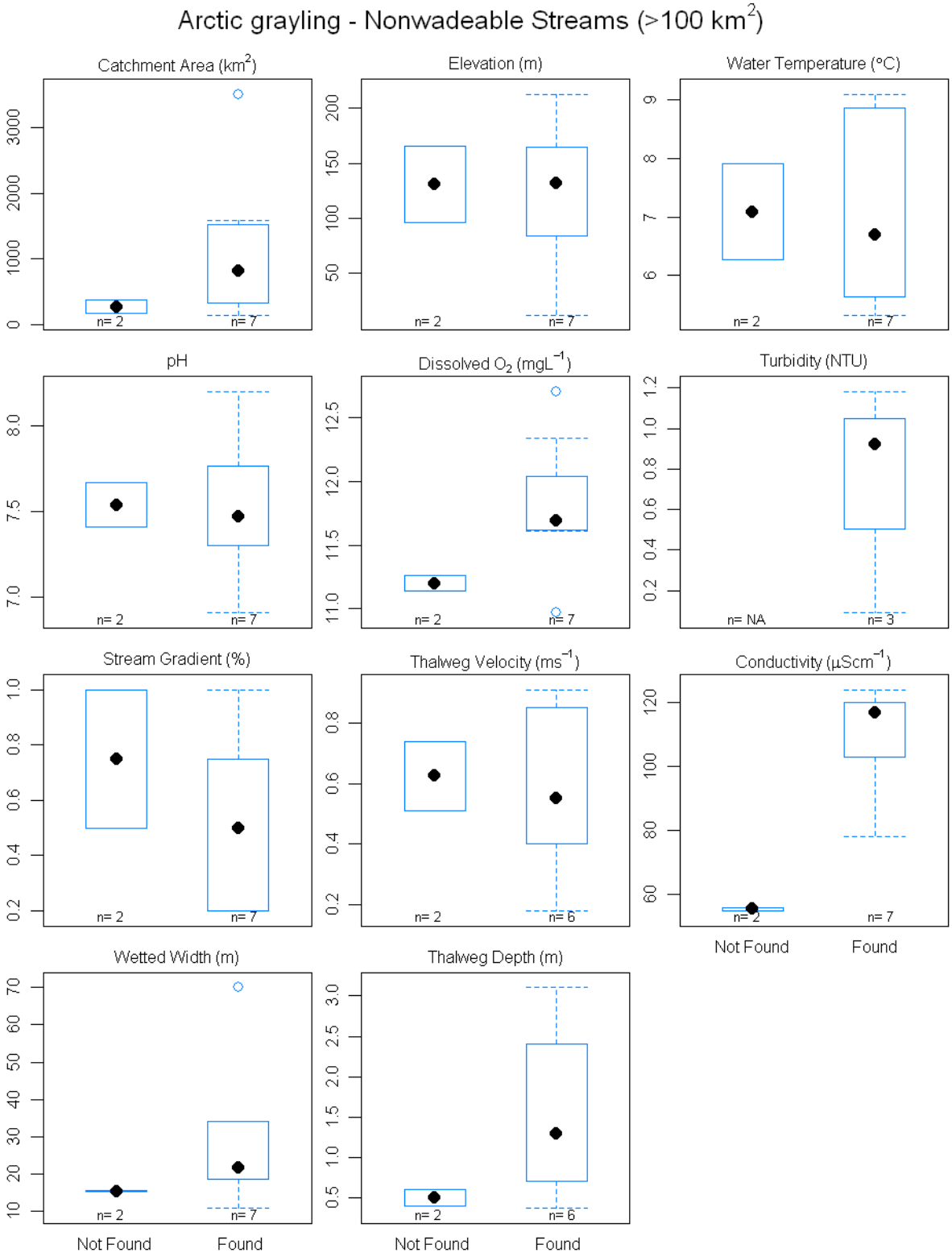


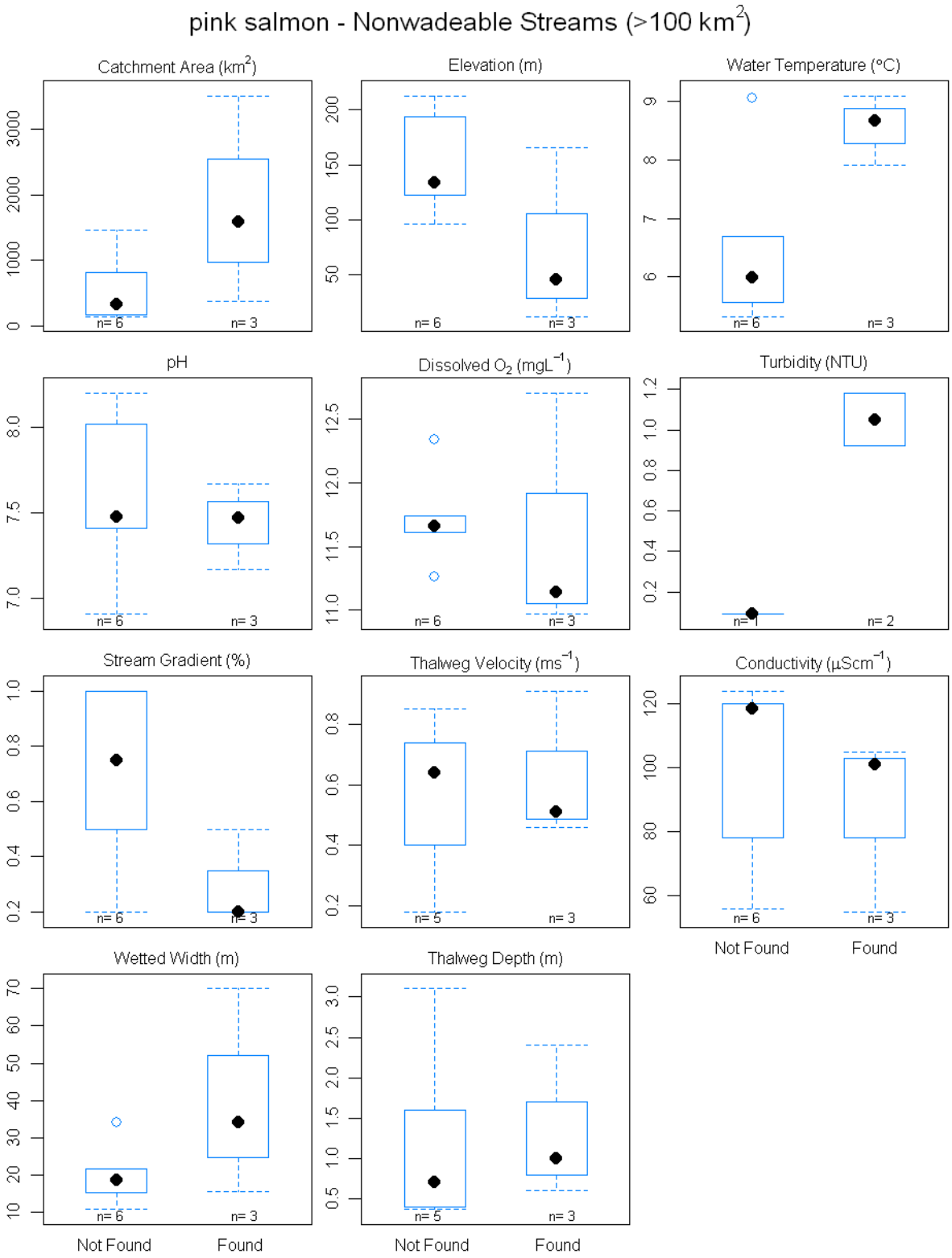
Note: Stream-size categories are based on drainage area (sq. km) upstream of each station (i.e., catchment area). Small streams, < 100 sq. km; Medium streams, 100–500 sq. km; Large streams, > 500 sq. km. Individual fish lengths from all reaches within each stream-size category were pooled.

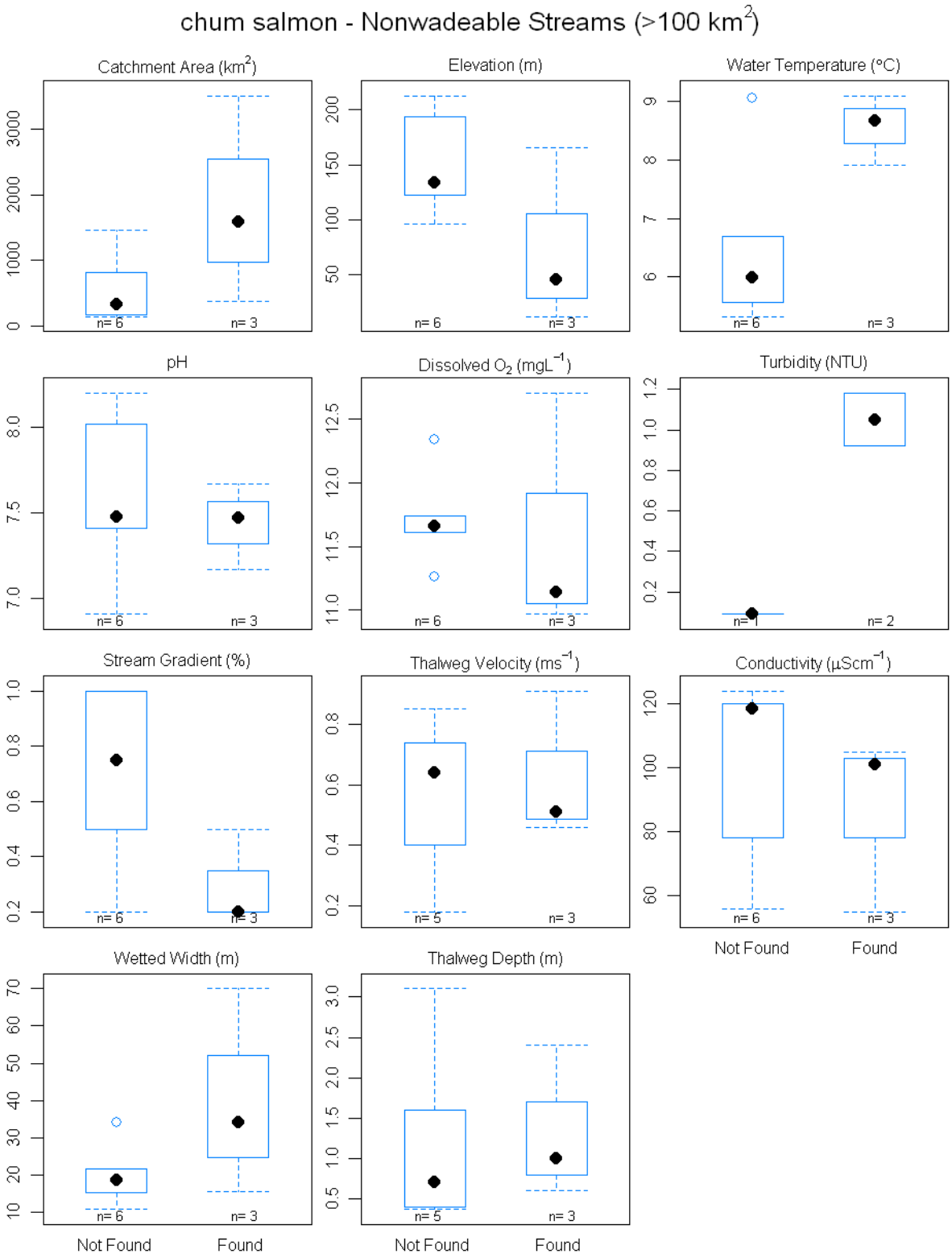
Appendix G4.–Paired box plots of continuous habitat variable distributions grouped by species occurrence and stream size.

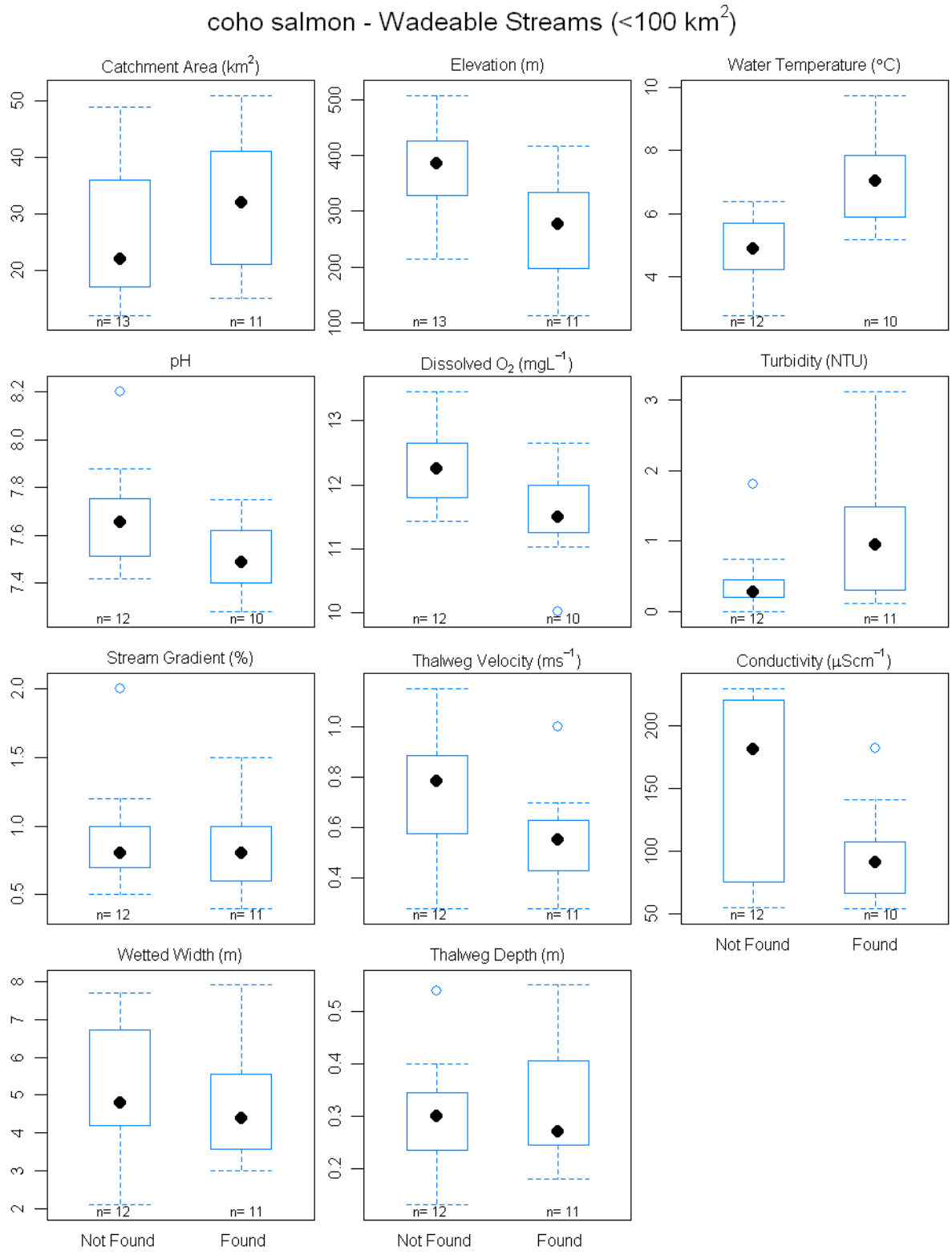


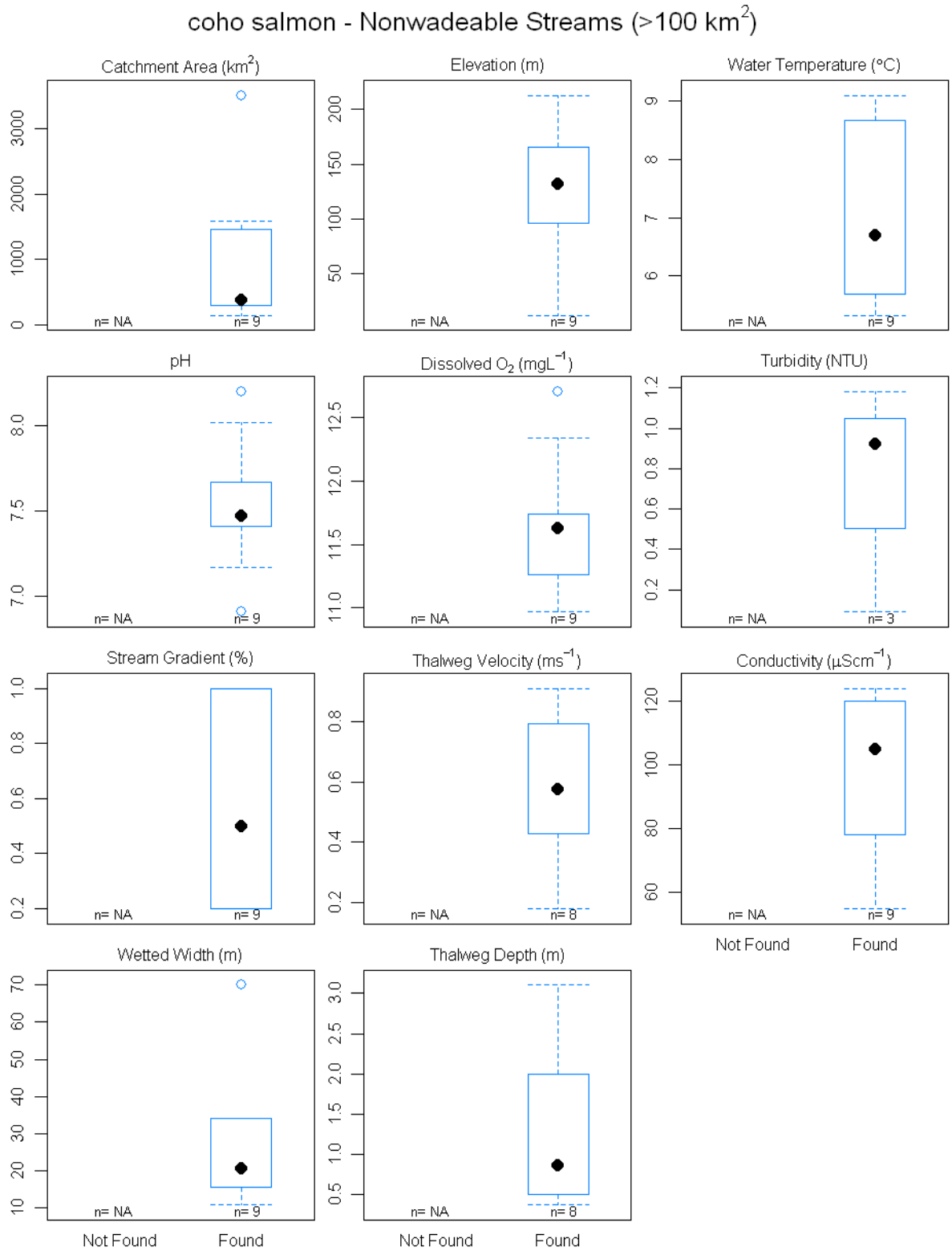

round whitefish - Nonwadeable Streams (>100 km^2)
Catchment Area (km^2)
Elevation (m)
Water Temperature (°C)
pH
Dissolved O_2 (mgL^{-1})
Turbidity (NTU)
Stream Gradient (%)
Thalweg Velocity (ms^{-1})
Conductivity (µScm^{-1})
Wetted Width (m)
Thalweg Depth (m)
n= 6
n= 3
n= 5
n= 1
n= 2
Not Found
Found

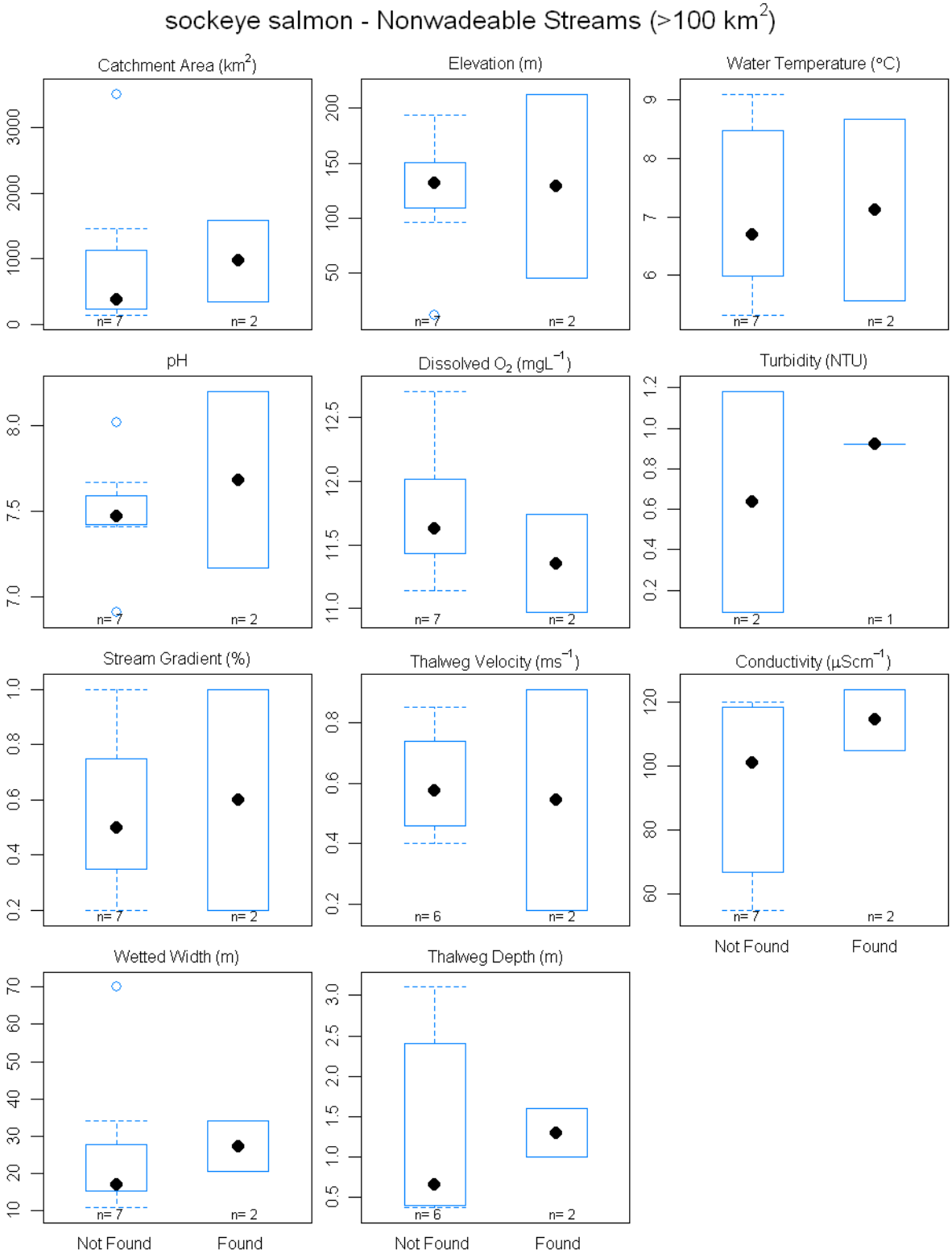

Arctic grayling - Nonwadeable Streams (>100 km2)
Catchment Area (km2)
Elevation (m)
Water Temperature (°C)
pH
Dissolved O2 (mgL-1)
Turbidity (NTU)
Stream Gradient (%)
Thalweg Velocity (ms-1)
Conductivity (µScm-1)
Wetted Width (m)
Thalweg Depth (m)
n= 2
n= 7
n= 6
n= NA
n= 3
Not Found
Found

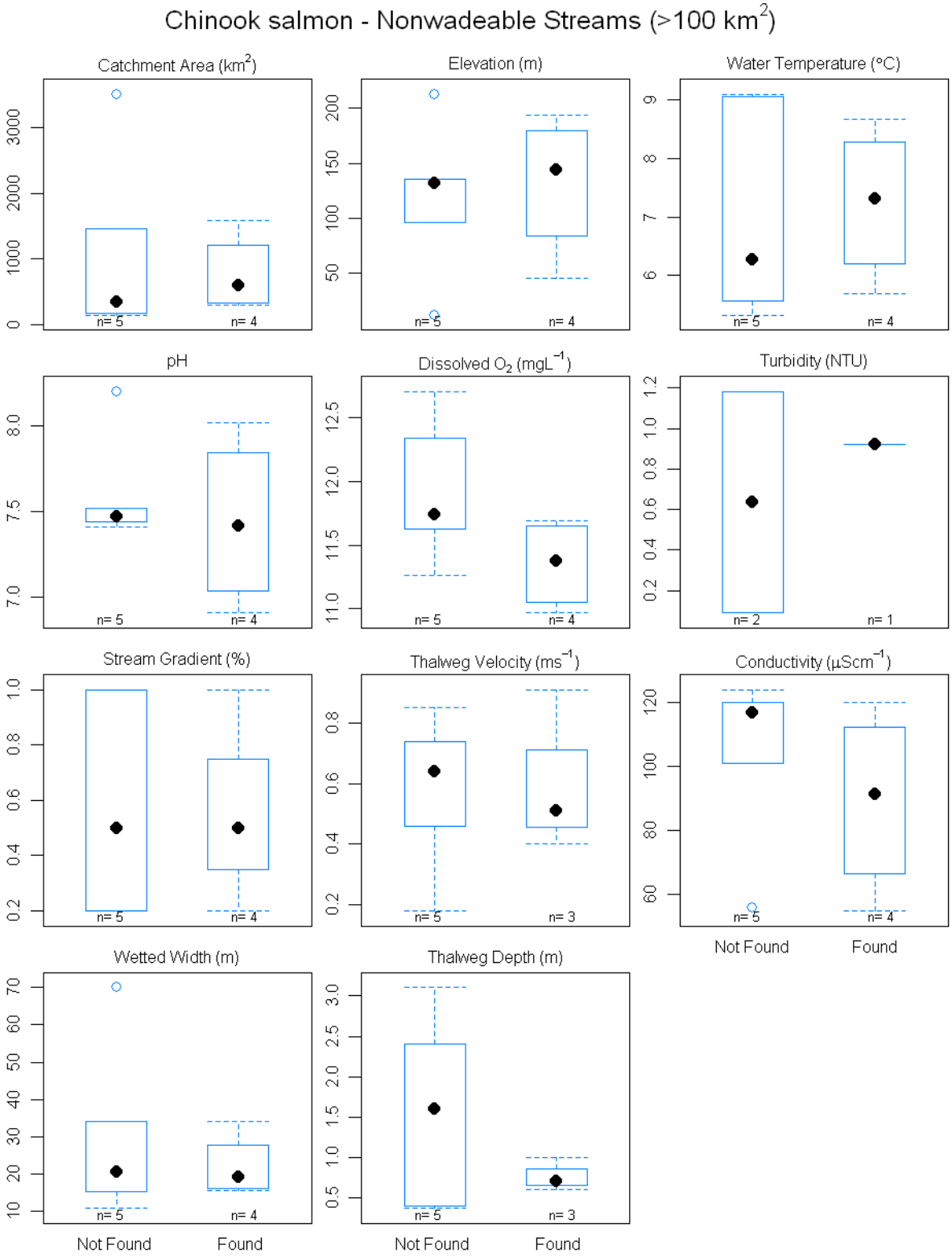

pink salmon - Nonwadeable Streams (>100 km2)
Catchment Area (km2)
Elevation (m)
Water Temperature (°C)
pH
Dissolved O2 (mgL-1)
Turbidity (NTU)
Stream Gradient (%)
Thalweg Velocity (ms-1)
Conductivity (µScm-1)
Wetted Width (m)
Thalweg Depth (m)
n= 6
n= 3
n= 5
n= 2
Not Found
Found

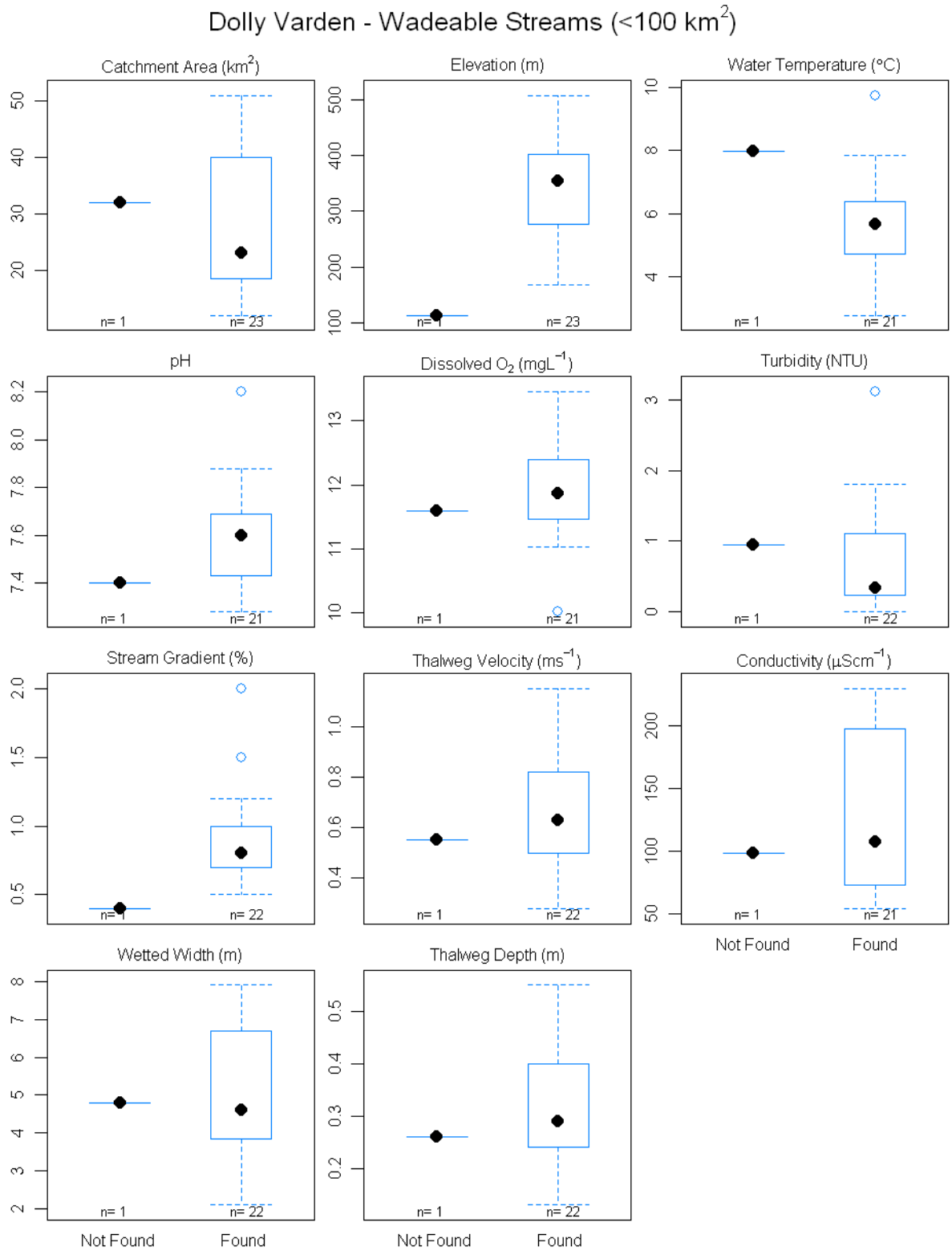

chum salmon - Nonwadeable Streams (>100 km2)
Catchment Area (km2)
Elevation (m)
Water Temperature (°C)
pH
Dissolved O2 (mgL-1)
Turbidity (NTU)
Stream Gradient (%)
Thalweg Velocity (ms-1)
Conductivity (µScm-1)
Wetted Width (m)
Thalweg Depth (m)
n= 6
n= 3
n= 5
n= 2
n= 1
Not Found
Found

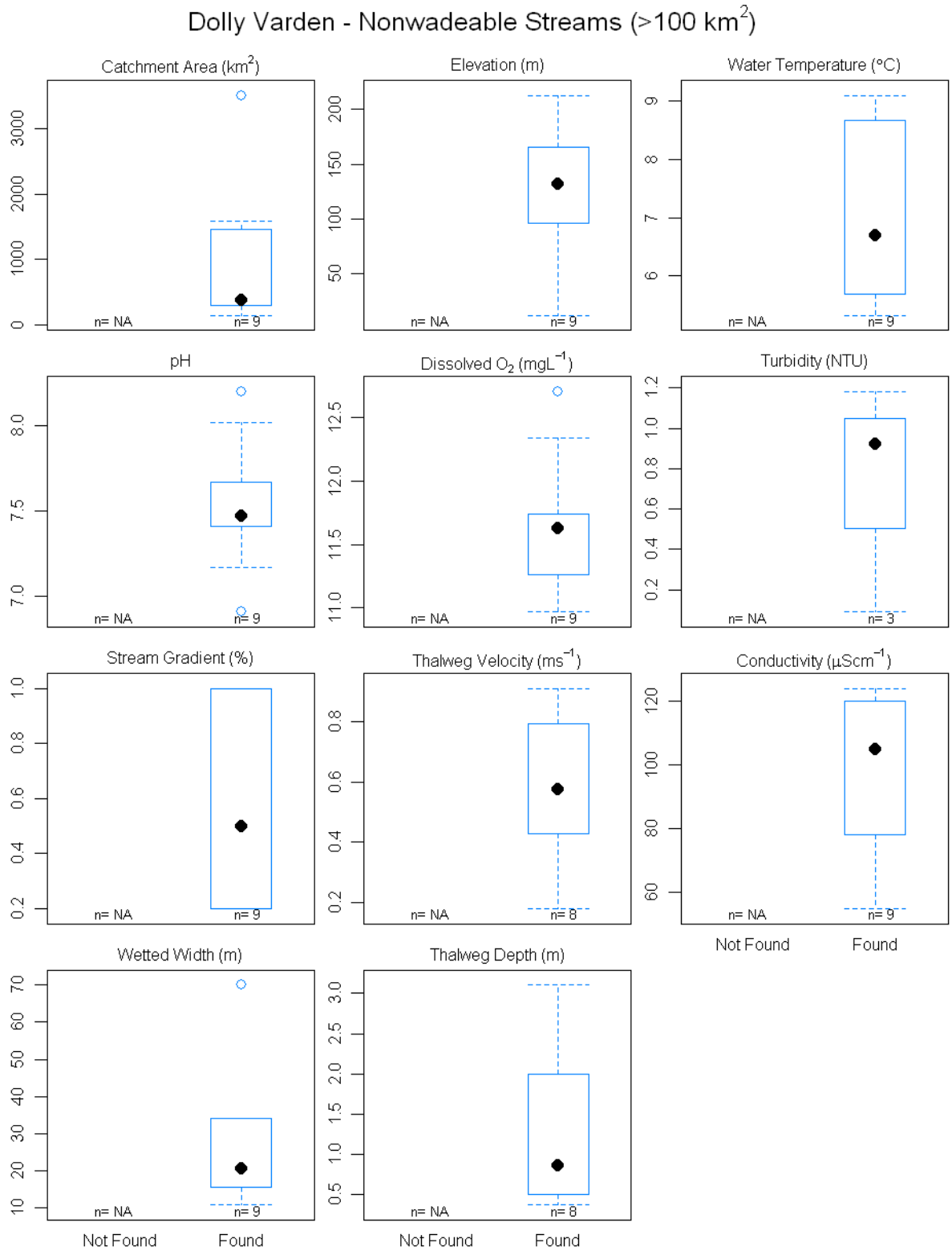

coho salmon - Wadeable Streams (<100 km2)
Catchment Area (km2)
Elevation (m)
Water Temperature (°C)
pH
Dissolved O2 (mgL-1)
Turbidity (NTU)
Stream Gradient (%)
Thalweg Velocity (ms-1)
Conductivity (µScm-1)
Wetted Width (m)
Thalweg Depth (m)
n= 13
n= 11
n= 12
n= 10
Not Found
Found

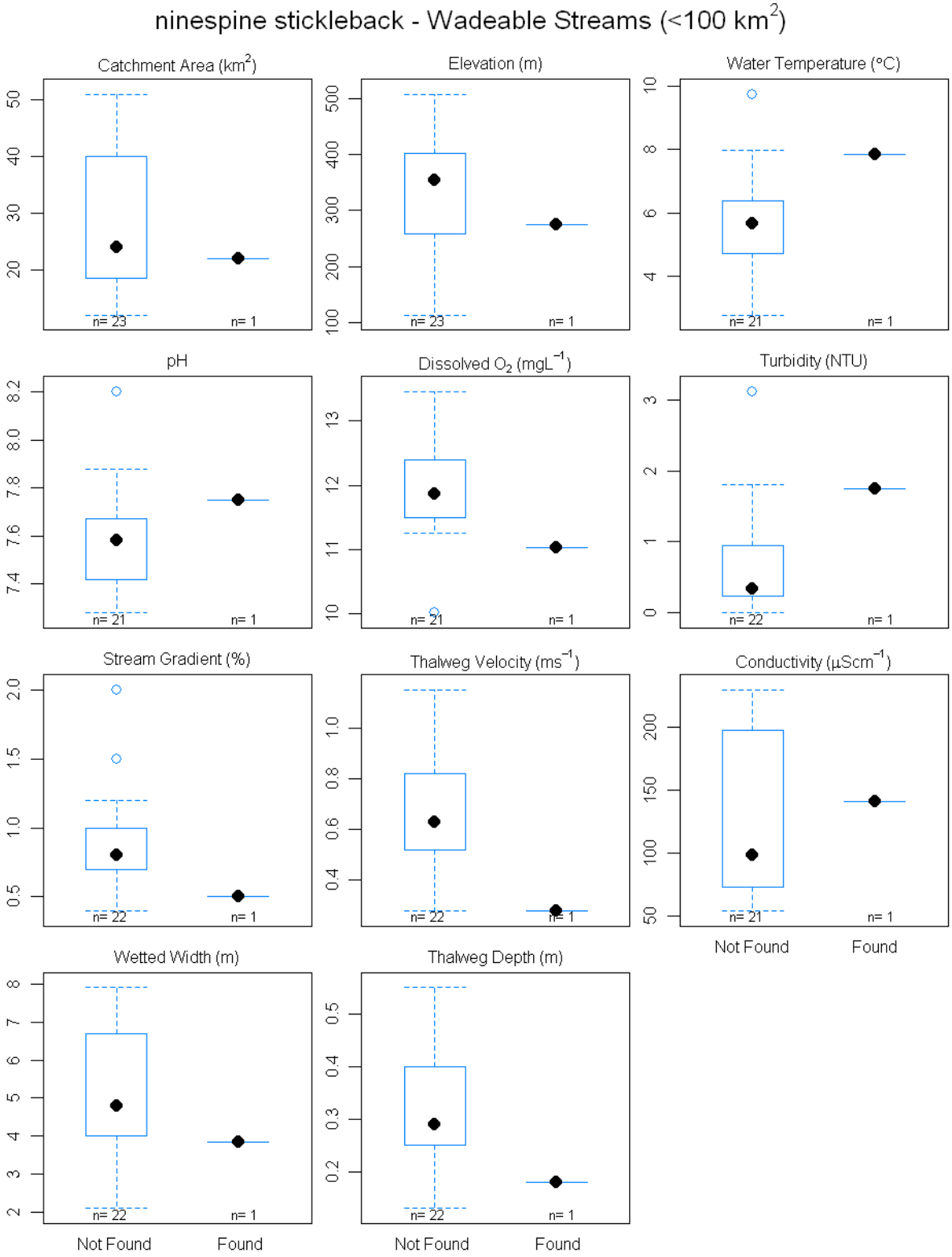

coho salmon - Nonwadeable Streams (>100 km2)
Catchment Area (km2)
Elevation (m)
Water Temperature (°C)
pH
Dissolved O2 (mgL-1)
Turbidity (NTU)
Stream Gradient (%)
Thalweg Velocity (ms-1)
Conductivity (µScm-1)
Wetted Width (m)
Thalweg Depth (m)
n= NA
n= 9
n= 8
n= 3
Not Found
Found

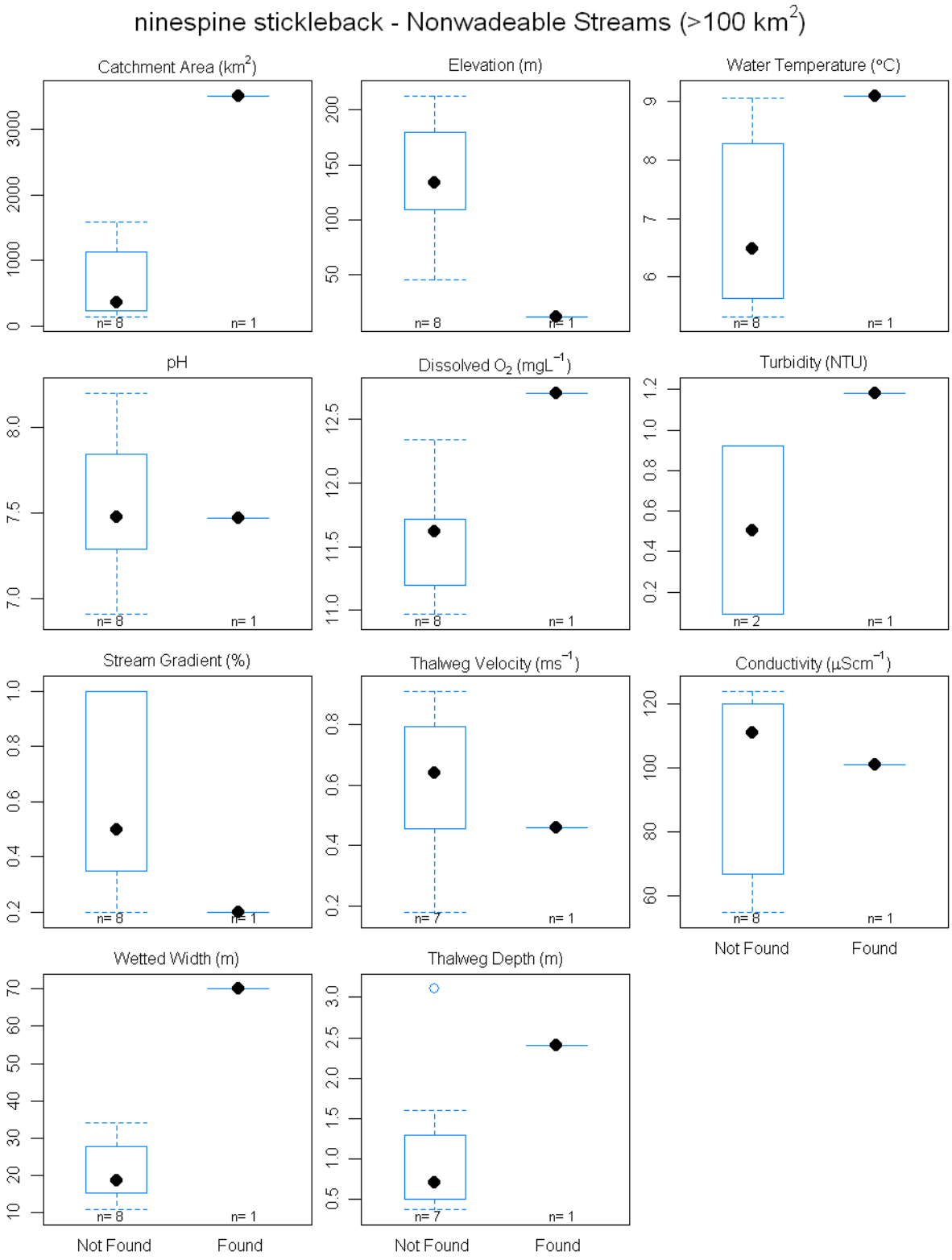

sockeye salmon - Nonwadeable Streams (>100 km2)
Catchment Area (km2)
Elevation (m)
Water Temperature (°C)
pH
Dissolved O2 (mgL-1)
Turbidity (NTU)
Stream Gradient (%)
Thalweg Velocity (ms-1)
Conductivity (µScm-1)
Wetted Width (m)
Thalweg Depth (m)
n= 7
n= 2
n= 6
n= 1
Not Found
Found

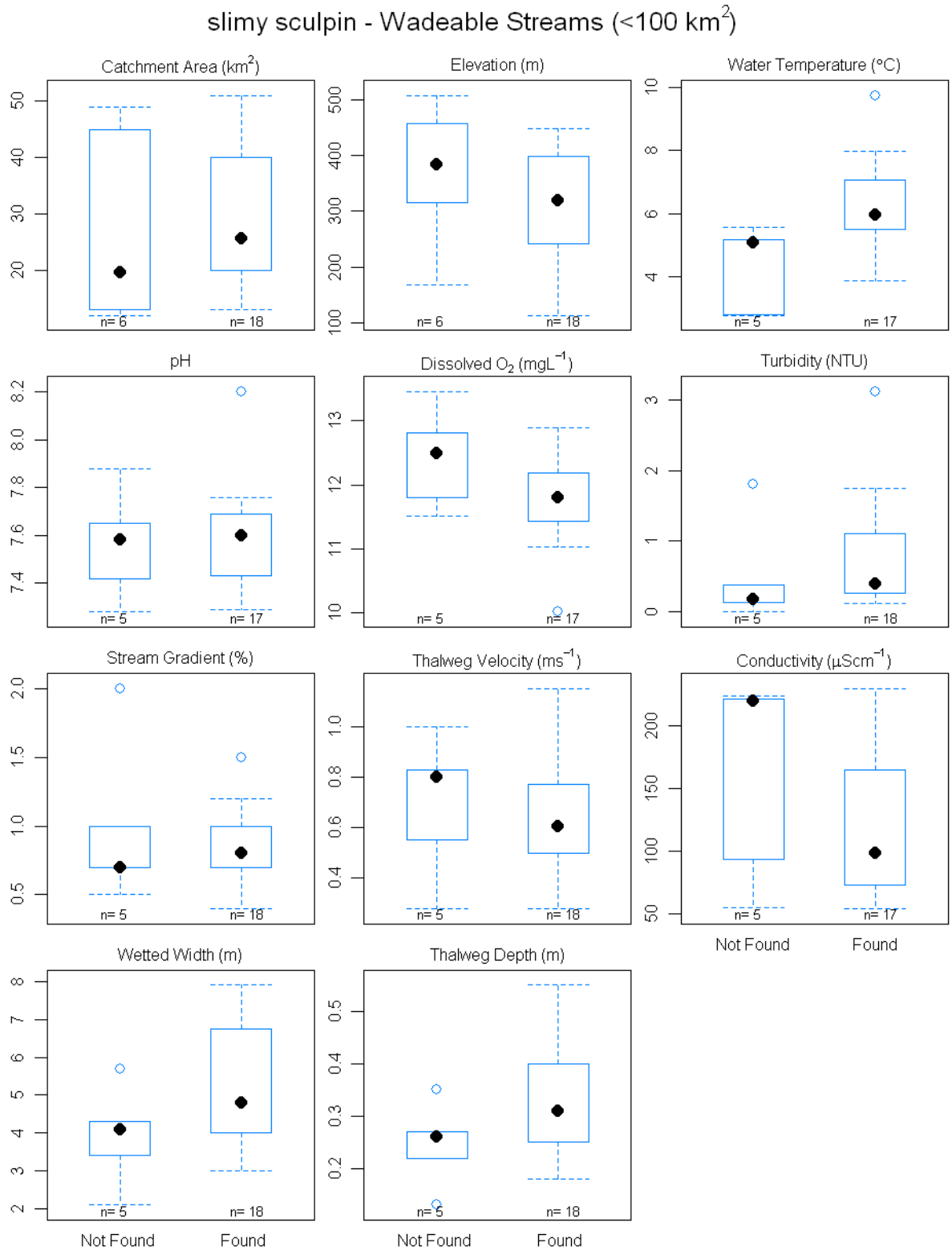

Chinook salmon - Nonwadeable Streams (>100 km2)
Catchment Area (km2)
Elevation (m)
Water Temperature (°C)
pH
Dissolved O2 (mgL-1)
Turbidity (NTU)
Stream Gradient (%)
Thalweg Velocity (ms-1)
Conductivity (µScm-1)
Wetted Width (m)
Thalweg Depth (m)
n= 5
n= 4
n= 3
n= 2
n= 1
Not Found
Found

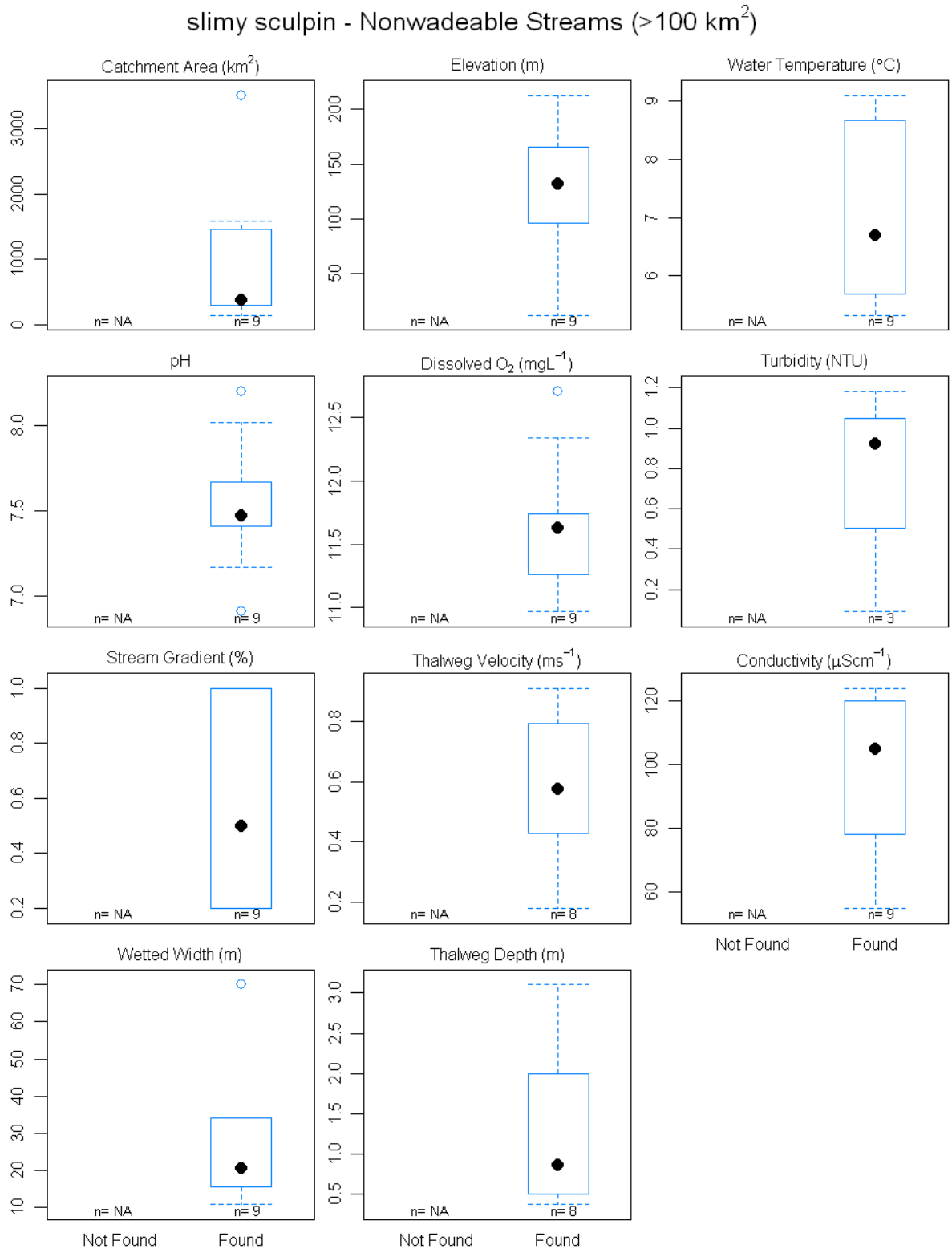

Dolly Varden - Wadeable Streams (<100 km2)
Catchment Area (km2)
Elevation (m)
Water Temperature (°C)
pH
Dissolved O2 (mgL-1)
Turbidity (NTU)
Stream Gradient (%)
Thalweg Velocity (ms-1)
Conductivity (µScm-1)
Wetted Width (m)
Thalweg Depth (m)
n= 1
n= 23
n= 21
n= 22
Not Found
Found


Dolly Varden - Nonwadeable Streams (>100 km2)
Catchment Area (km2)
Elevation (m)
Water Temperature (°C)
pH
Dissolved O2 (mgL-1)
Turbidity (NTU)
Stream Gradient (%)
Thalweg Velocity (ms-1)
Conductivity (µScm-1)
Wetted Width (m)
Thalweg Depth (m)
n= NA
n= 9
n= 8
n= 3
Not Found
Found

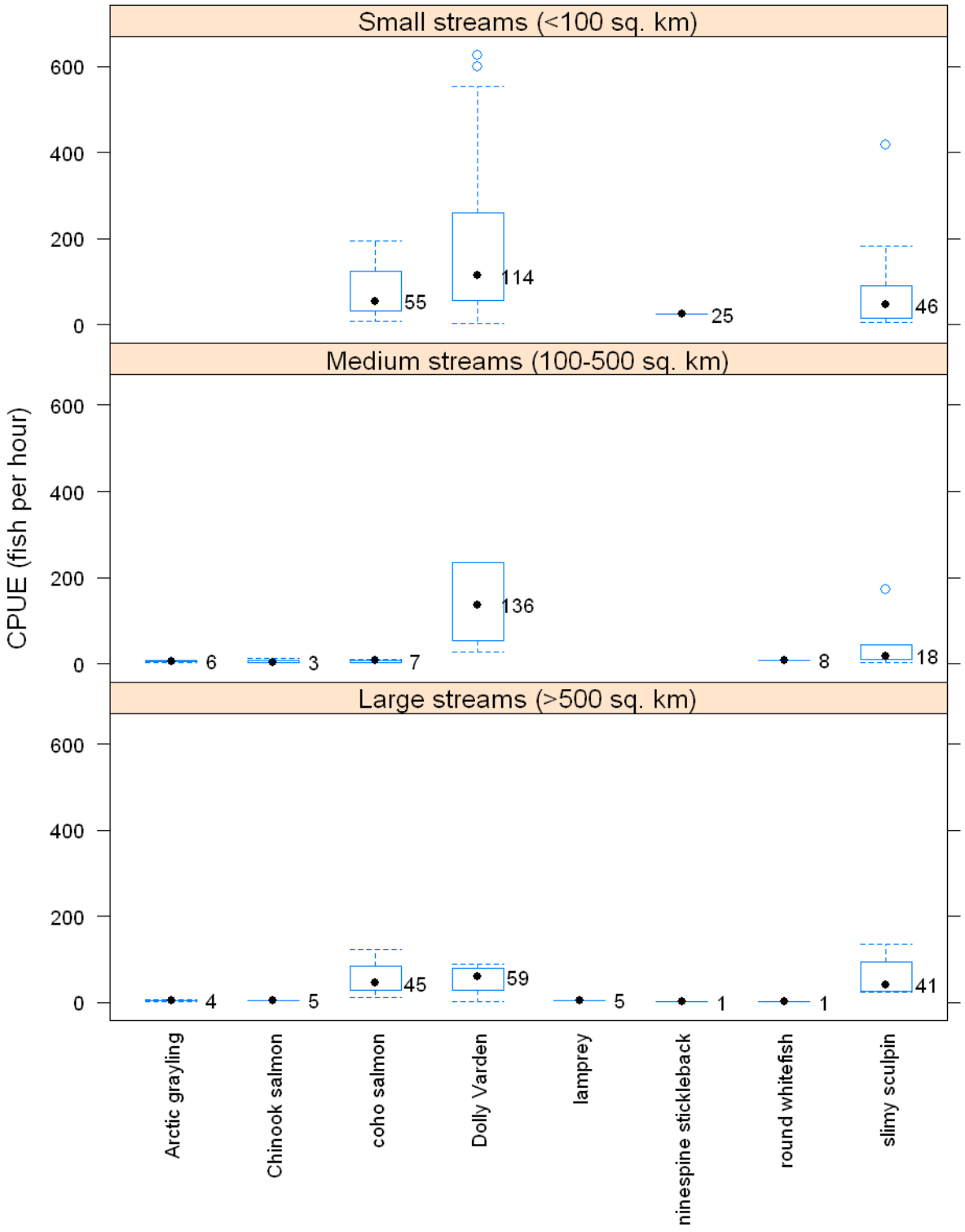

ninespine stickleback - Wadeable Streams (<100 km2)
Catchment Area (km2)
Elevation (m)
Water Temperature (°C)
pH
Dissolved O2 (mgL-1)
Turbidity (NTU)
Stream Gradient (%)
Thalweg Velocity (ms-1)
Conductivity (µScm-1)
Wetted Width (m)
Thalweg Depth (m)
n= 23
n= 1
n= 21
n= 22
Not Found
Found


ninespine stickleback - Nonwadeable Streams (>100 km2)
Catchment Area (km2)
Elevation (m)
Water Temperature (°C)
pH
Dissolved O2 (mgL-1)
Turbidity (NTU)
Stream Gradient (%)
Thalweg Velocity (ms-1)
Conductivity (µScm-1)
Wetted Width (m)
Thalweg Depth (m)
n= 8
n= 1
n= 7
n= 2
Not Found
Found


slimy sculpin - Wadeable Streams (<100 km2)
Catchment Area (km2)
Elevation (m)
Water Temperature (°C)
pH
Dissolved O2 (mgL-1)
Turbidity (NTU)
Stream Gradient (%)
Thalweg Velocity (ms-1)
Conductivity (µScm-1)
Wetted Width (m)
Thalweg Depth (m)
n= 6
n= 18
n= 5
n= 17
Not Found
Found


slimy sculpin - Nonwadeable Streams (>100 km2)
Catchment Area (km2)
Elevation (m)
Water Temperature (°C)
pH
Dissolved O2 (mgL-1)
Turbidity (NTU)
Stream Gradient (%)
Thalweg Velocity (ms-1)
Conductivity (µScm-1)
Wetted Width (m)
Thalweg Depth (m)
n= NA
n= 9
n= 8
n= 3
Not Found
Found

Appendix G5.–Box plots of electrofishing catch per unit effort (when the given species was detected), grouped by stream size.



Note: Box plots display the median CPUE value (•), which is labeled; upper and lower quartiles (upper and lower edges of box); extreme values (upper and lower ends of whiskers); and outliers (o).

APPENDIX H. SUPPLEMENTAL DATA ANALYSIS

Appendix H1.–Table of p-values from randomization tests for differences in the median of selected numeric habitat variables between stream-size groups.

Stream-size pair	water temp.	conductivity	turbidity	dissolved oxygen	pH	thalweg depth	channel width	stream gradient	thalweg velocity	elevation
Large - Medium	0.04	~	-	~	~	**<0.001**	**<0.001**	~	0.05	~
Large - Small	**0.004**	~	0.05	~	~	**<0.001**	**<0.001**	0.007	~	**0.001**
Medium - Small	~	~	-	~	~	**<0.001**	**<0.001**	~	~	**<0.001**

Note: "-" indicates the sample size was insufficient; i.e., the given variable was measured at <4 sites in one or both stream-size groups.

"~" indicates the *p*-value was > 0.05.

Low *p*-values (≤0.05) suggest the given habitat variable differs among the given stream-size groups. Very low p-values (≤0.005), in bold, strongly suggest a difference. Grey shading behind a *p*-value indicates the median for the larger stream-size group was less than the median for the smaller stream-size group. No shading indicates the median for the larger stream-size group was greater than for the smaller stream-size group.

Appendix H2.–Table of *p*-values from randomization tests for differences in the median of fish fork-lengths, and number of species found, between stream-size groups.

Stream-size pair	round whitefish	Arctic grayling	Dolly Varden	juv. coho salmon	juv. Chinook salmon	slimy sculpin	no. of species
Large - Medium	-	-	-	**<0.001**	-	~	0.05
Large - Small	-	-	0.009	0.037	-	~	**<0.001**
Medium - Small	-	-	**<0.001**	**<0.001**	-	~	**<0.001**

Note: "-" indicates the sample size was insufficient; i.e., the given variable was measured at <3 sites, or <10 fish were measured, in one or both stream-size groups.

"~" indicates the *p*-value was > 0.05.

Low *p*-values (≤0.05) suggest the given habitat variable differs among the given stream-size groups. Very low p-values (≤0.005), in bold, strongly suggest a difference. Grey shading behind a *p*-value indicates the median for the larger stream-size group was less than the median for the smaller stream-size group. No shading indicates the median for the larger stream-size group was greater than for the smaller stream-size group.

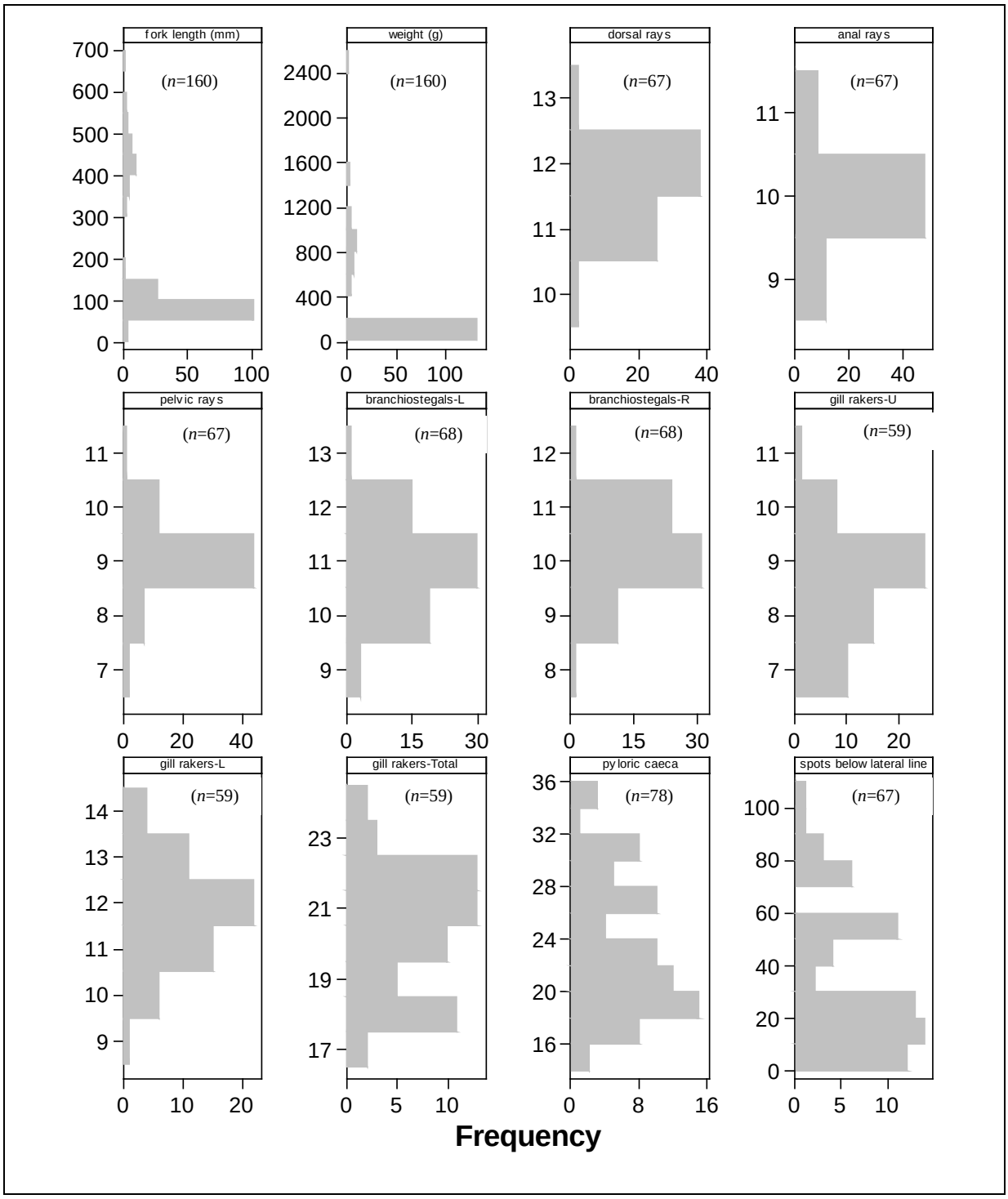
Appendix H3.–Table of *p*-values from randomization tests for differences in the median of selected numeric habitat variables between groups of sites where each fish species was found versus not found, grouped by stream size.

Species	Catchment area	Elevation	Water temp	pH	Dissolved oxygen	Turbidity	Conductivity	Stream gradient	Thalweg velocity	Wetted width	Thalweg depth
Wadeable (<100 km^2) streams											
coho salmon	~	0.04	**<0.001**	~	0.006	0.012	0.017	~	0.024	~	~
Dolly Varden	~	0.042	~	~	~	~	~	0.047	~	~	~
slimy sculpin	~	~	~	~	~	0.044	0.019	~	~	~	~
ninespine stickleback	-	-	-	-	-	-	-	-	-	-	-
All nonwadeable (>100 km^2) streams											
Lamprey	-	-	-	-	-	-	-	-	-	-	-
round whitefish	~	~	~	0.04	~	~	~	~	~	~	~
Arctic grayling	~	~	~	~	~	~	~	~	~	~	~
pink salmon	0.03	~	~	~	~	~	~	~	~	~	~
chum salmon	0.03	~	~	~	~	~	~	~	~	~	~
coho salmon	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>
sockeye salmon	-	-	-	-	-	-	-	-	-	-	-
Chinook salmon	~	~	~	~	~	~	~	~	~	~	~
Dolly Varden	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>
ninespine stickleback	-	-	-	-	-	-	-	-	-	-	-
slimy sculpin	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>

Note: "~" indicates the *p*-value was > 0.05. "-" indicates insufficient sample size (<3 samples from where the species was found/not found). "<>" indicates that the species was present at all sites and no comparison can be made. Low *p*-values (≤0.05) suggest the given habitat variable differs between sites where the species was found versus not found. Very low p-values (≤0.005), in bold font, strongly suggest a difference. Grey shading behind a *p*-value indicates the median for sites where the species was found was less than the median for sites where the species was not found. No shading behind a *p*-value indicates the median for sites where the species was found was greater.

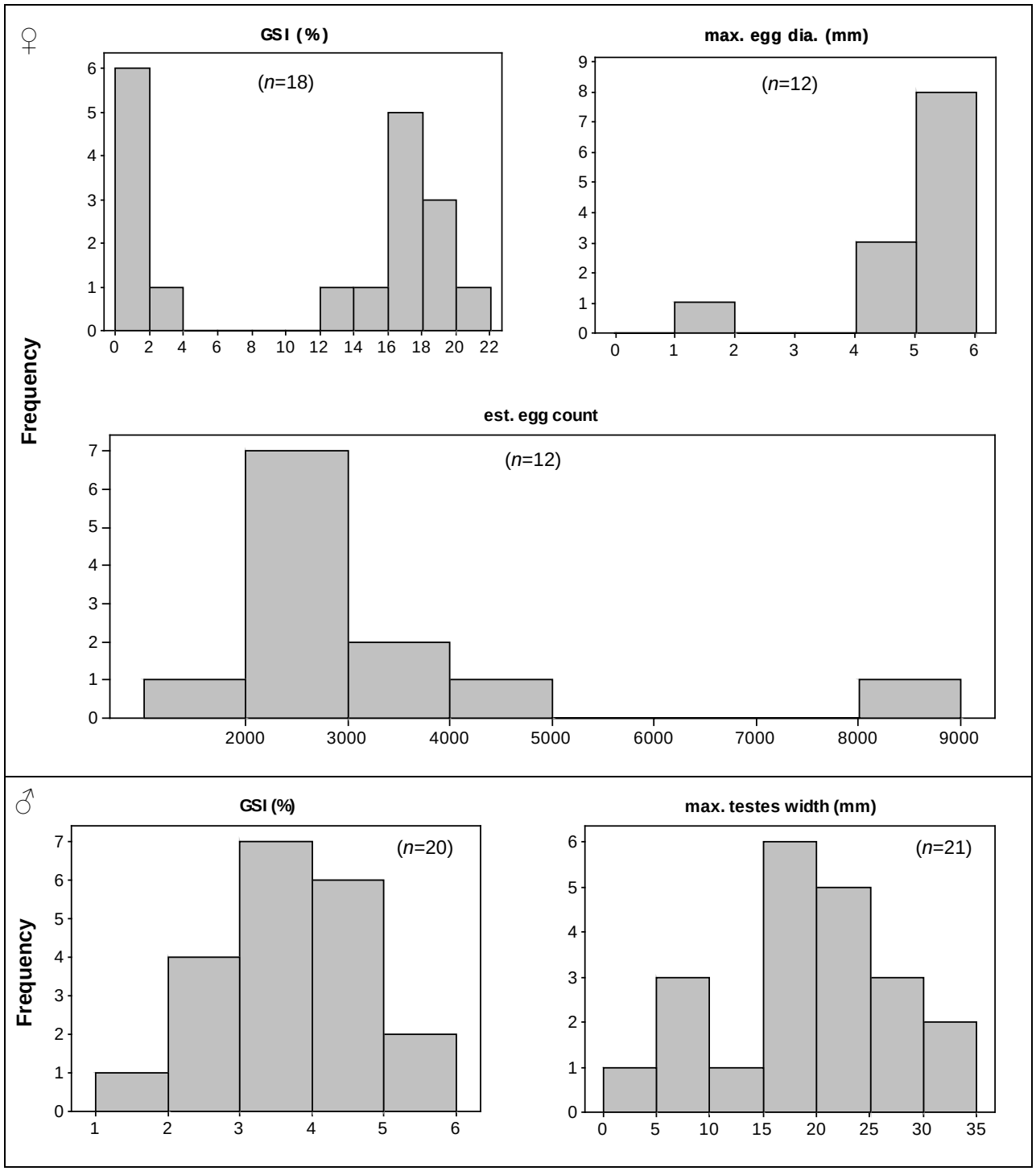
APPENDIX I. MERISTIC AND GONAD DATA FROM RETAINED DOLLY VARDEN SPECIMENS

Appendix I1.–Meristic data from Dolly Varden specimens retained for otolith-chemistry study.



Note: Fish were previously frozen then thawed. Fin rays counted from fin on fish's left-side. Gill rakers counted from the 1st arch on the fish's right side. Rakers in the angle between the upper and lower limb were included with the lower-limb count.

Appendix I2.–Gonad data from Dolly Varden specimens retained for otolith-chemistry study.



Notes: Fish were previously frozen, then thawed. Top panel shows gonad data for female, and bottom panel male, specimens. *GSI* (gonado-somatic index) is gonad mass as a percent of total body mass. Egg count was estimated as total ovary weight × no. of eggs counted from a sample taken from a tranverse section through the center of an ovary ÷ ovary sample weight.

APPENDIX J. INDIVIDUAL STUDY-SITE SUMMARY REPORTS AND PHOTOS

Station Info

Observers: Cecil Rich, Gillian O'Doherty **Date/Time:** 08/20/2009 4:41 PM

Reach Coordinates (Upstream / Downstream)	Latitude	Longitude	/	Latitude	Latitude	Elevation NED (m)(ft): 12 39
	63.91770	-160.33345	/	63.91153	-160.36901	

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83
USGS Quadrangle: Unalakleet D-3 **Legal Description (MTRS):** K018S009W24
Waterbody Name: Unalakleet River
Anadromous Waters Catalog Number: 333-60-10100
Geographic Comments: Just below confluence with Chiroskey River.

Visit Comments:
Wildlife Comments:

Water Quality \ Stream Flow

Water Temp (C): 9.10 **DO (mg/L):** 12.70 **Conductivity (µS/cm):** 101 **Turbidity (NTU):** 1.18 **pH:** 7.47
Water Color: Clear **Thalweg Velocity (m/s)(ft/s):** 0.46 1.51

Stream Channel

Stream Gradient (%): 0.2 **Catchment Area(sq. km):** Does

Channel Dimensions (m):	Bank Full	Wetted	Dominant Substrate: Gravel
Width	78.0	70.0	Subdominant Substrate 1:
Thalweg Depth	4.80	2.40	Subdominant Substrate 2: Sand/Silt/Clay

Rosgen Class: C4 Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well-defined floodplains.

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5	Closed Tall Alder-Willow Shrub	3	Closed Tall Willow Shrub	4
5 - 10	Closed Tall Alder Shrub	4	Closed Tall Willow Shrub	4
10 - 20	Closed Tall Alder Shrub	4	Closed Tall Willow Shrub	4
20 - 30	Closed Tall Alder Shrub	4	Closed Tall Willow Shrub	4

Key To Fish Sampling Methods

Estimated reach length (m): 5554 **Total Electrofishing Time (s):** 3999

(BEF) Boat-Mounted Electrofisher
(VOB) Visual Observation, Boat

Fish Observations

Species: Dolly Varden **Life Stage:** adult **Life History:** Unknown
Total Fish Count: 18 **Fish Measured:** 2 **Fork Lengths (mm)** **Min:** 116 **Max:** 350 **Mean:** 233 **Median:** 233
Sampling Method (No. of fish): BEF (2) VOB (16)
Comments:

Species: Arctic grayling **Life Stage:** adult **Life History:** Resident
Total Fish Count: 8 **Fish Measured:** 1 **Fork Lengths (mm)** **Min:** 392 **Max:** 392 **Mean:** 392 **Median:** 392
Sampling Method (No. of fish): BEF (1) VOB (7)
Comments:

Species: Arctic grayling **Life Stage:** juvenile/adult **Life History:** Resident
Total Fish Count: 2 **Fish Measured:** 2 **Fork Lengths (mm)** **Min:** 204 **Max:** 206 **Mean:** 205 **Median:** 205
Sampling Method (No. of fish): BEF (2)
Comments:

Species: Arctic grayling **Life Stage:** juvenile **Life History:** Resident
Total Fish Count: 3 **Fish Measured:** 3 **Fork Lengths (mm)** **Min:** 58 **Max:** 184 **Mean:** 121 **Median:** 121
Sampling Method (No. of fish): BEF (3)
Comments:

-continued-

Species: ninespine stickleback **Life Stage:** juvenile **Life History:** Unknown
Total Fish Count: 1 **Fish Measured:** 1 **Fork Lengths (mm)** **Min:** 34 **Max:** 34 **Mean:** 34 **Median:** 34
Sampling Method (No. of fish): BEF (1)
Comments:

Species: lamprey-unspecified **Life Stage:** juvenile **Life History:** Unknown
Total Fish Count: 8 **Fish Measured:** 5 **Fork Lengths (mm)** **Min:** 90 **Max:** 190 **Mean:** 157 **Median:** 140
Sampling Method (No. of fish): BEF (5) VOB (3)
Comments:

Species: chum salmon **Life Stage:** adult **Life History:** Anadromous
Total Fish Count: 3 **Fish Measured:** **Fork Lengths (mm)** **Min:** **Max:** **Mean:** **Median:**
Sampling Method (No. of fish): VOB (3)
Comments:

Species: coho salmon **Life Stage:** adult **Life History:** Anadromous
Total Fish Count: 76 **Fish Measured:** **Fork Lengths (mm)** **Min:** **Max:** **Mean:** **Median:**
Sampling Method (No. of fish): VOB (76)
Comments:

Species: coho salmon **Life Stage:** juvenile **Life History:** Anadromous
Total Fish Count: 17 **Fish Measured:** 13 **Fork Lengths (mm)** **Min:** 63 **Max:** 116 **Mean:** 77 **Median:** 89
Sampling Method (No. of fish): BEF (13) VOB (4)
Comments:

Species: pink salmon **Life Stage:** adult **Life History:** Anadromous
Total Fish Count: 56 **Fish Measured:** **Fork Lengths (mm)** **Min:** **Max:** **Mean:** **Median:**
Sampling Method (No. of fish): VOB (56)
Comments:

Species: slimy sculpin **Life Stage:** adult **Life History:** Resident
Total Fish Count: 11 **Fish Measured:** 11 **Fork Lengths (mm)** **Min:** 74 **Max:** 94 **Mean:** 80 **Median:** 84
Sampling Method (No. of fish): BEF (11)
Comments:

Species: slimy sculpin **Life Stage:** juvenile/adult **Life History:** Resident
Total Fish Count: 335 **Fish Measured:** 10 **Fork Lengths (mm)** **Min:** 57 **Max:** 68 **Mean:** 63 **Median:** 62
Sampling Method (No. of fish): BEF (10) VOB (325)
Comments:

Species: slimy sculpin **Life Stage:** juvenile **Life History:** Resident
Total Fish Count: 13 **Fish Measured:** 13 **Fork Lengths (mm)** **Min:** 16 **Max:** 43 **Mean:** 30 **Median:** 29
Sampling Method (No. of fish): BEF (13)
Comments:

Instruments

Stream Gradient:

Stream Velocity: Price AA meter

Turbidity: LaMotte 2020e turbidimeter

Water Quality: YSI 556

Channel Depths: handheld sonar depth finder

Channel Widths: handheld laser rangefinder

Electrofisher: Smith-Root GPP 2.5

-continued-

FSW0914A010825.jp

FSW0914A010826.jp

Station Info

Observers: Joe Buckwalter, Tim Sundlov **Date/Time:** 08/20/2009 10:51 AM

Reach Coordinates (Upstream / Downstream)	Latitude	Longitude	/	Latitude	Latitude	Elevation NED (m)(ft): 136 446
	64.38970	-160.47411	/	64.40148	-160.47616	

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83
USGS Quadrangle: Norton Bay B-3 **Legal Description (MTRS):** K013S009W04
Waterbody Name: Anakeksik Creek
Anadromous Waters Catalog Number: 333-50-10100-2300
Geographic Comments:
Visit Comments: Turbidity meter broken. Very low turbidity (<1 NTU). Stream gradient likely ~0.75% (visual estimate).
Wildlife Comments: Grizzly bear seen downstream from helicopter.

Water Quality \ Stream Flow

Water Temp (C): 5.33 **DO (mg/L):** 12.34 **Conductivity (µS/cm):** 120 **Turbidity (NTU):** **pH:** 7.44
Water Color: Clear **Thalweg Velocity (m/s)(ft/s):** 0.64 2.10

Stream Channel

Stream Gradient (%): 0.2 **Catchment Area(sq. km):** Does

Channel Dimensions (m):	Bank Full	Wetted	
Width	13.2	10.6	**Subdominant Substrate 1:**
Thalweg Depth	0.76	0.37	**Subdominant Substrate 2:** Gravel

Dominant Substrate: Cobble

Rosgen Class: C3 Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well-defined floodplains.

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5	Open White Spruce Forest	5	Closed Low Willow Shrub	1
5 - 10	Open White Spruce Forest	5	Unvegetated	
10 - 20	Open White Spruce Forest	5	Unvegetated	
20 - 30	Open White Spruce Forest	5	Closed Tall Willow Shrub	3

Key To Fish Sampling Methods

Estimated reach length (m): 1505 **Total Electrofishing Time (s):** 1531

(BEF) Boat-Mounted Electrofisher
(DIP) Dip Net
(VOB) Visual Observation, Boat
(VOG) Visual Observation, Ground

Fish Observations

Species: Dolly Varden **Life Stage:** adult spawning **Life History:** Unknown
Total Fish Count: 24 **Fish Measured:** 9 **Fork Lengths (mm)** **Min:** 405 **Max:** 522 **Mean:** 457 **Median:** 463
Sampling Method (No. of fish): BEF (17) VOB (5) VOG (2)
Comments: These dollies are likely anadromous, based on their large size, proximity to saltwater, and low food availability a

Species: Dolly Varden **Life Stage:** juvenile/adult **Life History:** Unknown
Total Fish Count: 10 **Fish Measured:** 10 **Fork Lengths (mm)** **Min:** 86 **Max:** 135 **Mean:** 105 **Median:** 110
Sampling Method (No. of fish): BEF (10)
Comments:

Species: Dolly Varden **Life Stage:** juvenile **Life History:** Unknown
Total Fish Count: 21 **Fish Measured:** 11 **Fork Lengths (mm)** **Min:** 43 **Max:** 73 **Mean:** 57 **Median:** 58
Sampling Method (No. of fish): BEF (11) VOB (10)
Comments:

Species: Arctic grayling **Life Stage:** adult **Life History:** Resident
Total Fish Count: 2 **Fish Measured:** 1 **Fork Lengths (mm)** **Min:** 435 **Max:** 435 **Mean:** 435 **Median:** 435
Sampling Method (No. of fish): BEF (1) VOB (1)
Comments:

-continued-

Species: Arctic grayling **Life Stage:** juvenile/adult **Life History:** Resident
Total Fish Count: 1 **Fish Measured:** 1 **Fork Lengths (mm)** **Min:** 300 **Max:** 300 **Mean:** 300 **Median:** 300
Sampling Method (No. of fish): BEF (1)
Comments:

Species: coho salmon **Life Stage:** juvenile **Life History:** Anadromous
Total Fish Count: 47 **Fish Measured:** 12 **Fork Lengths (mm)** **Min:** 33 **Max:** 43 **Mean:** 38 **Median:** 38
Sampling Method (No. of fish): DIP (12) VOB (35)
Comments:

Species: slimy sculpin **Life Stage:** adult **Life History:** Resident
Total Fish Count: 13 **Fish Measured:** 13 **Fork Lengths (mm)** **Min:** 69 **Max:** 80 **Mean:** 72 **Median:** 74
Sampling Method (No. of fish): BEF (13)
Comments:

Species: slimy sculpin **Life Stage:** juvenile/adult **Life History:** Resident
Total Fish Count: 142 **Fish Measured:** 19 **Fork Lengths (mm)** **Min:** 52 **Max:** 67 **Mean:** 61 **Median:** 59
Sampling Method (No. of fish): BEF (42) VOB (100)
Comments:

Species: slimy sculpin **Life Stage:** juvenile **Life History:** Resident
Total Fish Count: 2 **Fish Measured:** 2 **Fork Lengths (mm)** **Min:** 41 **Max:** 49 **Mean:** 45 **Median:** 45
Sampling Method (No. of fish): BEF (2)
Comments:

Instruments

Stream Gradient:

Stream Velocity: Price AA meter

Turbidity:

Water Quality: YSI 556

Channel Depths: graduated wading rod

Channel Widths: measuring tape

Electrofisher: Smith-Root GPP 2.5

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FSW0914B010410.jp

FSW0914B010412.jp

FSW0914B010418.jp

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FSW0914B010419.jp

FSW0914B010420.jp

FSW0914B010426.jp

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FSW0914B010427.jp

Station Info

Observers: Jonathan Kirsch, Andrew Levi **Date/Time:** 08/20/2009 2:15 PM

Reach Coordinates (Upstream / Downstream)	Latitude	Longitude	/	Latitude	Latitude	Elevation NED (m)(ft):
	63.54055	-160.77289	/	63.54239	-160.77092	306 1004

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83
USGS Quadrangle: Unalakleet C-4 **Legal Description (MTRS):** K022S011W34
Waterbody Name: South River
Anadromous Waters Catalog Number: 333-60-10100-2036
Geographic Comments:
Visit Comments:
Wildlife Comments:

Water Quality \ Stream Flow

Water Temp (C): 7.00 **DO (mg/L):** 11.26 **Conductivity (µS/cm):** 82 **Turbidity (NTU):** 0.37 **pH:** 7.41
Water Color: Clear **Thalweg Velocity (m/s)(ft/s):** 0.65 2.13

Stream Channel

Stream Gradient (%): 0.8 **Catchment Area(sq. km):** Does

Channel Dimensions (m):	Bank Full	Wetted
Width	10.3	7.9
Thalweg Depth	0.41	0.21

Dominant Substrate: Gravel
Subdominant Substrate 1: Sand/Silt/Clay
Subdominant Substrate 2: Cobble

Rosgen Class: C4 Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well-defined floodplains.

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5	Open Low Willow Shrub	2.2	Open Low Willow Shrub	2.2
5 - 10	Open Low Willow Shrub	2.2	Open Low Willow Shrub	2.2
10 - 20	Open Low Willow Shrub	2.2	Open Low Willow Shrub	2.2
20 - 30	Open Low Willow Shrub	2.2	Open Low Willow Shrub	2.2

Key To Fish Sampling Methods

Estimated reach length (m): 300

(PEF) Portable Electrofisher (VOG) Visual Observation, Ground

Fish Observations

Species: Dolly Varden **Life Stage:** juvenile/adult **Life History:** Unknown
Total Fish Count: 29 **Fish Measured:** 9 **Fork Lengths (mm)** **Min:** 82 **Max:** 155 **Mean:** 111 **Median:** 118
Sampling Method (No. of fish): PEF (9) VOG (20)
Comments:

Species: Dolly Varden **Life Stage:** juvenile **Life History:** Unknown
Total Fish Count: 1 **Fish Measured:** 1 **Fork Lengths (mm)** **Min:** 75 **Max:** 75 **Mean:** 75 **Median:** 75
Sampling Method (No. of fish): PEF (1)
Comments:

Species: coho salmon **Life Stage:** juvenile **Life History:** Anadromous
Total Fish Count: 53 **Fish Measured:** 33 **Fork Lengths (mm)** **Min:** 54 **Max:** 96 **Mean:** 79 **Median:** 75
Sampling Method (No. of fish): PEF (33) VOG (20)
Comments:

Species: slimy sculpin **Life Stage:** adult **Life History:** Resident
Total Fish Count: 7 **Fish Measured:** 7 **Fork Lengths (mm)** **Min:** 70 **Max:** 85 **Mean:** 73 **Median:** 77
Sampling Method (No. of fish): PEF (7)
Comments:

-continued-

Species: slimy sculpin **Life Stage:** juvenile/adult **Life History:** Resident
Total Fish Count: 162 **Fish Measured:** 12 **Fork Lengths (mm)** **Min:** 51 **Max:** 65 **Mean:** 58 **Median:** 58
Sampling Method (No. of fish): PEF (12) VOG (150)
Comments:

Species: slimy sculpin **Life Stage:** juvenile **Life History:** Resident
Total Fish Count: 7 **Fish Measured:** 7 **Fork Lengths (mm)** **Min:** 15 **Max:** 48 **Mean:** 38 **Median:** 31
Sampling Method (No. of fish): PEF (7)
Comments:

Instruments

Stream Gradient: handheld abney level
Stream Velocity: Orange Float
Turbidity: LaMotte 2020e turbidimeter
Water Quality: YSI 556
Channel Depths: graduated wading rod
Channel Widths: measuring tape
Electrofisher: Smith-Root LR-24

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FSW0914C010082.jp

FSW0914C010083.jp

FSW0914C010084.jp

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FSW0914C010085.jp

Station Info

Observers: Jonathan Kirsch, Andrew Levi **Date/Time:** 08/20/2009 4:00 PM

Reach Coordinates (Upstream / Downstream)	Latitude	Longitude	/	Latitude	Latitude	Elevation NED (m)(ft):
	63.61623	-160.61040	/	63.61806	-160.60844	277 909

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83
USGS Quadrangle: Unalakleet C-4 **Legal Description (MTRS):** K022S010W04
Waterbody Name:
Anadromous Waters Catalog Number: 333-60-10100-2036-3111
Geographic Comments:
Visit Comments:
Wildlife Comments:

Water Quality \ Stream Flow

Water Temp (C): 9.75 **DO (mg/L):** 10.02 **Conductivity (µS/cm):** 182 **Turbidity (NTU):** 1.63 **pH:** 7.62
Water Color: Clear **Thalweg Velocity (m/s)(ft/s):** 0.36 1.18

Stream Channel

Stream Gradient (%): 1 **Catchment Area(sq. km):** Does

Channel Dimensions (m):	Bank Full	Wetted
Width	5.5	4.4
Thalweg Depth	0.35	0.55

Dominant Substrate: Cobble
Subdominant Substrate 1: Sand/Silt/Clay
Subdominant Substrate 2: Gravel

Rosgen Class: C3 Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well-defined floodplains.

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5	Closed Tall Willow Shrub	2.2	Closed Tall Willow Shrub	2.2
5 - 10	Closed Tall Willow Shrub	2.2	Open Black Spruce Forest	10
10 - 20	Closed Tall Willow Shrub	4	Open Black Spruce Forest	10
20 - 30	Open Black Spruce Forest	10	Closed Low Willow Shrub	1.5

Key To Fish Sampling Methods

Estimated reach length (m): 200

(PEF) Portable Electrofisher (VOG) Visual Observation, Ground

Fish Observations

Species: Dolly Varden **Life Stage:** juvenile/adult **Life History:** Unknown
Total Fish Count: 47 **Fish Measured:** 22 **Fork Lengths (mm)** **Min:** 89 **Max:** 155 **Mean:** 118 **Median:** 122
Sampling Method (No. of fish): PEF (22) VOG (25)
Comments:

Species: Dolly Varden **Life Stage:** juvenile **Life History:** Unknown
Total Fish Count: 5 **Fish Measured:** 5 **Fork Lengths (mm)** **Min:** 65 **Max:** 76 **Mean:** 71 **Median:** 70
Sampling Method (No. of fish): PEF (5)
Comments:

Species: coho salmon **Life Stage:** juvenile **Life History:** Anadromous
Total Fish Count: 61 **Fish Measured:** 11 **Fork Lengths (mm)** **Min:** 46 **Max:** 102 **Mean:** 66 **Median:** 74
Sampling Method (No. of fish): PEF (11) VOG (50)
Comments:

Species: slimy sculpin **Life Stage:** adult **Life History:** Resident
Total Fish Count: 9 **Fish Measured:** 9 **Fork Lengths (mm)** **Min:** 70 **Max:** 101 **Mean:** 79 **Median:** 85
Sampling Method (No. of fish): PEF (9)
Comments:

-continued-

Species: slimy sculpin **Life Stage:** juvenile/adult **Life History:** Resident
Total Fish Count: 218 **Fish Measured:** 18 **Fork Lengths (mm)** **Min:** 51 **Max:** 68 **Mean:** 57 **Median:** 59
Sampling Method (No. of fish): PEF (18) VOG (200)
Comments:

Species: slimy sculpin **Life Stage:** juvenile **Life History:** Resident
Total Fish Count: 2 **Fish Measured:** 2 **Fork Lengths (mm)** **Min:** 45 **Max:** 49 **Mean:** 47 **Median:** 47
Sampling Method (No. of fish): PEF (2)
Comments:

Instruments

Stream Gradient: handheld abney level
Stream Velocity: Orange Float
Turbidity: LaMotte 2020e turbidimeter
Water Quality: YSI 556
Channel Depths: graduated wading rod
Channel Widths: measuring tape
Electrofisher: Smith-Root LR-24

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FSW0914C020087.jp

FSW0914C020088.jp

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FSW0914C020089.jp

Station Info

Observers: Jonathan Kirsch, Andrew Levi **Date/Time:** 08/20/2009 5:12 PM

Reach Coordinates (Upstream / Downstream)	Latitude	Longitude	/	Latitude	Latitude	Elevation NED (m)(ft): 275 902
	63.51274	-160.58493	/	63.51319	-160.58404	

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83
USGS Quadrangle: Unalakleet C-4 **Legal Description (MTRS):** K023S010W10
Waterbody Name: Chiroskey River
Anadromous Waters Catalog Number: 333-60-10100-2130
Geographic Comments:
Visit Comments:
Wildlife Comments:

Water Quality \ Stream Flow

Water Temp (C): 7.85 **DO (mg/L):** 11.04 **Conductivity (µS/cm):** 141 **Turbidity (NTU):** 1.74 **pH:** 7.75
Water Color: Clear **Thalweg Velocity (m/s)(ft/s):** 0.28 0.92

Stream Channel

Stream Gradient (%): 0.5 **Catchment Area(sq. km):** Does

Channel Dimensions (m):	Bank Full	Wetted
Width	5.4	3.8
Thalweg Depth	0.40	0.18

Dominant Substrate: Gravel
Subdominant Substrate 1: Cobble
Subdominant Substrate 2: Sand/Silt/Clay

Rosgen Class: C4 Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well-defined floodplains.

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5	Bluejoint-Herb	1.5	Bluejoint-Herb	1.5
5 - 10	Bluejoint-Herb	1.5	Bluejoint-Herb	1.5
10 - 20	Bluejoint-Herb	1.5	Bluejoint-Herb	1.5
20 - 30	Bluejoint-Herb	1.5	Bluejoint-Herb	1.5

Key To Fish Sampling Methods

Estimated reach length (m): 165

(PEF) Portable Electrofisher (VOG) Visual Observation, Ground

Fish Observations

Species: Dolly Varden **Life Stage:** juvenile/adult **Life History:** Unknown
Total Fish Count: 52 **Fish Measured:** 2 **Fork Lengths (mm)** **Min:** 89 **Max:** 101 **Mean:** 95 **Median:** 95
Sampling Method (No. of fish): PEF (2) VOG (50)
Comments:

Species: Dolly Varden **Life Stage:** juvenile **Life History:** Unknown
Total Fish Count: 3 **Fish Measured:** 3 **Fork Lengths (mm)** **Min:** 59 **Max:** 80 **Mean:** 66 **Median:** 69
Sampling Method (No. of fish): PEF (3)
Comments:

Species: ninespine stickleback **Life Stage:** adult **Life History:** Resident
Total Fish Count: 3 **Fish Measured:** 3 **Fork Lengths (mm)** **Min:** 69 **Max:** 72 **Mean:** 70 **Median:** 70
Sampling Method (No. of fish): PEF (3)
Comments:

Species: coho salmon **Life Stage:** juvenile **Life History:** Anadromous
Total Fish Count: 18 **Fish Measured:** 8 **Fork Lengths (mm)** **Min:** 74 **Max:** 97 **Mean:** 83 **Median:** 85
Sampling Method (No. of fish): PEF (8) VOG (10)
Comments:

-continued-

Species: slimy sculpin **Life Stage:** adult **Life History:** Resident
Total Fish Count: 6 **Fish Measured:** 6 **Fork Lengths (mm)** **Min:** 69 **Max:** 89 **Mean:** 79 **Median:** 79
Sampling Method (No. of fish): PEF (6)
Comments:

Species: slimy sculpin **Life Stage:** juvenile/adult **Life History:** Resident
Total Fish Count: 115 **Fish Measured:** 15 **Fork Lengths (mm)** **Min:** 50 **Max:** 65 **Mean:** 59 **Median:** 57
Sampling Method (No. of fish): PEF (15) VOG (100)
Comments:

Species: slimy sculpin **Life Stage:** juvenile **Life History:** Resident
Total Fish Count: 1 **Fish Measured:** 1 **Fork Lengths (mm)** **Min:** 49 **Max:** 49 **Mean:** 49 **Median:** 49
Sampling Method (No. of fish): PEF (1)
Comments:

Instruments

Stream Gradient: handheld abney level
Stream Velocity: Orange Float
Turbidity: LaMotte 2020e turbidimeter
Water Quality: YSI 556
Channel Depths: graduated wading rod
Channel Widths: measuring tape
Electrofisher: Smith-Root LR-24

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FSW0914C030091.jp

FSW0914C030092.jp

FSW0914C030093.jp

Station Info

Observers: Tim Sundlov, Jacob Ivanoff **Date/Time:** 08/21/2009 12:10 PM

Reach Coordinates (Upstream / Downstream)	Latitude	Longitude	/	Latitude	Latitude	Elevation NED (m)(ft): 122 400
	64.10274	-159.53868	/	64.10167	-159.55973	

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83
USGS Quadrangle: Norton Bay A-2 **Legal Description (MTRS):** K016S004W18
Waterbody Name: Unalakleet River
Anadromous Waters Catalog Number: 333-60-10100
Geographic Comments: We started the survey downstream of CU02B, because of log jams upstream. Photo #'s: 430-431, 432, 434, 436-437.

Visit Comments: Turbidity meter broken--visually the water is clear (< 1.0 NTU). Upper Unalakleet River. The LZ was downstream of the target stream waypoint because of upstream log jams. Stream velocity was performed with a Price AA meter.

Wildlife Comments:

Water Quality \ Stream Flow

Water Temp (C): 6.70 **DO (mg/L):** 11.69 **Conductivity (µS/cm):** 120 **Turbidity (NTU):** **pH:** 6.91
Water Color: Clear **Thalweg Velocity (m/s)(ft/s):** 0.40 1.31

Stream Channel

Stream Gradient (%): 0.5 **Catchment Area(sq. km):** Does

Channel Dimensions (m):	Bank Full	Wetted
Width	21.6	16.8
Thalweg Depth	1.13	0.71

Dominant Substrate: Gravel
Subdominant Substrate 1: Sand/Silt/Clay
Subdominant Substrate 2: Cobble

Rosgen Class: C4 Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well-defined floodplains.

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5	Unvegetated		Closed Tall Willow Shrub	5
5 - 10	Unvegetated		Closed Tall Willow Shrub	5
10 - 20	Closed Tall Willow Shrub	5	Closed Tall Willow Shrub	5
20 - 30	Open Balsam Poplar (Black Cottonwood) Forest	15	Open Balsam Poplar (Black Cottonwood) Forest	15

Key To Fish Sampling Methods

Estimated reach length (m): 1940 **Total Electrofishing Time (s):** 2701

(BEF) Boat-Mounted Electrofisher
(DIP) Dip Net
(VOB) Visual Observation, Boat

Fish Observations

Species: Dolly Varden **Life Stage:** adult **Life History:** Unknown
Total Fish Count: 24 **Fish Measured:** 9 **Fork Lengths (mm)** **Min:** 383 **Max:** 530 **Mean:** 454 **Median:** 456
Sampling Method (No. of fish): BEF (9) VOB (15) **Suspected Spawning:** Yes
Comments: These dollies are likely anadromous, based on their large size and proximity to the coast.

Species: Dolly Varden **Life Stage:** juvenile/adult **Life History:** Unknown
Total Fish Count: 4 **Fish Measured:** 4 **Fork Lengths (mm)** **Min:** 82 **Max:** 128 **Mean:** 111 **Median:** 105
Sampling Method (No. of fish): BEF (4)
Comments:

Species: Dolly Varden **Life Stage:** juvenile **Life History:** Unknown
Total Fish Count: 17 **Fish Measured:** 16 **Fork Lengths (mm)** **Min:** 46 **Max:** 79 **Mean:** 57 **Median:** 62
Sampling Method (No. of fish): BEF (16) VOB (1)
Comments:

-continued-

Species: Arctic grayling **Life Stage:** adult **Life History:** Resident
Total Fish Count: 9 **Fish Measured:** 3 **Fork Lengths (mm)** **Min:** 410 **Max:** 442 **Mean:** 429 **Median:** 426
Sampling Method (No. of fish): BEF (6) VOB (3)
Comments:

Species: Chinook salmon **Life Stage:** carcass **Life History:** Anadromous
Total Fish Count: 1 **Fish Measured:** **Fork Lengths (mm)** **Min:** **Max:** **Mean:** **Median:**
Sampling Method (No. of fish): VOB (1) **Suspected Spawning:** Yes
Comments:

Species: Chinook salmon **Life Stage:** juvenile **Life History:** Anadromous
Total Fish Count: 2 **Fish Measured:** 2 **Fork Lengths (mm)** **Min:** 55 **Max:** 64 **Mean:** 59 **Median:** 59
Sampling Method (No. of fish): BEF (2)
Comments:

Species: coho salmon **Life Stage:** adult **Life History:** Anadromous
Total Fish Count: 10 **Fish Measured:** **Fork Lengths (mm)** **Min:** **Max:** **Mean:** **Median:**
Sampling Method (No. of fish): VOB (10) **Suspected Spawning:** Yes
Comments:

Species: coho salmon **Life Stage:** juvenile **Life History:** Anadromous
Total Fish Count: 52 **Fish Measured:** 11 **Fork Lengths (mm)** **Min:** 35 **Max:** 78 **Mean:** 48 **Median:** 56
Sampling Method (No. of fish): BEF (5) DIP (8) VOB (39)
Comments:

Species: slimy sculpin **Life Stage:** adult **Life History:** Resident
Total Fish Count: 1 **Fish Measured:** 1 **Fork Lengths (mm)** **Min:** 75 **Max:** 75 **Mean:** 75 **Median:** 75
Sampling Method (No. of fish): BEF (1)
Comments:

Species: slimy sculpin **Life Stage:** juvenile/adult **Life History:** Resident
Total Fish Count: 3 **Fish Measured:** **Fork Lengths (mm)** **Min:** **Max:** **Mean:** **Median:**
Sampling Method (No. of fish): VOB (3)
Comments:

Species: slimy sculpin **Life Stage:** juvenile **Life History:** Resident
Total Fish Count: 1 **Fish Measured:** 1 **Fork Lengths (mm)** **Min:** 48 **Max:** 48 **Mean:** 48 **Median:** 48
Sampling Method (No. of fish): BEF (1)
Comments:

Species: round whitefish **Life Stage:** adult **Life History:** Resident
Total Fish Count: 15 **Fish Measured:** 6 **Fork Lengths (mm)** **Min:** 345 **Max:** 470 **Mean:** 384 **Median:** 407
Sampling Method (No. of fish): BEF (6) VOB (9)
Comments:

Instruments

Stream Gradient:

Stream Velocity: Price AA meter

Turbidity:

Water Quality: YSI 556

Channel Depths: graduated wading rod

Channel Widths: measuring tape

Electrofisher: Smith-Root GPP 2.5

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FSW0915B010432.jp

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FSW0915B010434.jp

FSW0915B010436.jp

FSW0915B010437.jp

Station Info

Observers: Jonathan Kirsch, Andrew Levi **Date/Time:** 08/21/2009 9:58 AM

Reach Coordinates (Upstream / Downstream)	Latitude	Longitude	/	Latitude	Latitude	Elevation NED (m)(ft):
	63.67643	-160.17528	/	63.67767	-160.17522	315 1033

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83
USGS Quadrangle: Unalakleet C-3 **Legal Description (MTRS):** K021S008W11
Waterbody Name:
Anadromous Waters Catalog Number:
Geographic Comments:
Visit Comments:
Wildlife Comments:

Water Quality \ Stream Flow

Water Temp (C): 5.07 **DO (mg/L):** 11.80 **Conductivity (µS/cm):** 224 **Turbidity (NTU):** 1.80 **pH:** 7.58
Water Color: Clear **Thalweg Velocity (m/s)(ft/s):** 0.83 2.72

Stream Channel

Stream Gradient (%): 1 **Catchment Area(sq. km):** Does

Channel Dimensions (m):	Bank Full	Wetted
Width	4.4	4.1
Thalweg Depth	0.32	0.22

Dominant Substrate: Cobble
Subdominant Substrate 1: Sand/Silt/Clay
Subdominant Substrate 2: Gravel

Rosgen Class: C3 Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well-defined floodplains.

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5	Closed Tall Willow Shrub	2.5	Closed Tall Willow Shrub	4.5
5 - 10	Closed Tall Willow Shrub	2.5	Closed Tall Willow Shrub	4.5
10 - 20	Closed Tall Willow Shrub	2.5	Closed Tall Willow Shrub	4.5
20 - 30	Closed Tall Willow Shrub	2.5	Closed Tall Willow Shrub	4.5

Key To Fish Sampling Methods

(PEF) Portable Electrofisher (VOG) Visual Observation, Ground

Fish Observations

Species: Dolly Varden **Life Stage:** adult spawning **Life History:** Unknown
Total Fish Count: 8 **Fish Measured:** 4 **Fork Lengths (mm)** **Min:** 320 **Max:** 540 **Mean:** 444 **Median:** 430
Sampling Method (No. of fish): PEF (4) VOG (4)
Comments: Probably anadromous dollies based on large size.

Species: Dolly Varden **Life Stage:** juvenile/adult **Life History:** Unknown
Total Fish Count: 11 **Fish Measured:** 11 **Fork Lengths (mm)** **Min:** 105 **Max:** 154 **Mean:** 124 **Median:** 129
Sampling Method (No. of fish): PEF (11)
Comments:

Species: Dolly Varden **Life Stage:** juvenile **Life History:** Unknown
Total Fish Count: 118 **Fish Measured:** 18 **Fork Lengths (mm)** **Min:** 36 **Max:** 75 **Mean:** 58 **Median:** 55
Sampling Method (No. of fish): PEF (18) VOG (100)
Comments:

Instruments

Stream Gradient: handheld abney level
Stream Velocity: Orange Float
Turbidity: LaMotte 2020e turbidimeter
Water Quality: YSI 556
Channel Depths: graduated wading rod
Channel Widths: measuring tape
Electrofisher: Smith-Root LR-24

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FSW0915C010097.jp

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FSW0915C010098.jp

Station Info

Observers: Jonathan Kirsch, Andrew Levi **Date/Time:** 08/21/2009 12:53 PM

Reach Coordinates (Upstream / Downstream)	Latitude	Longitude	/	Latitude	Latitude	Elevation NED (m)(ft): 188 617
	63.76537	-159.99370	/	63.76575	-159.99646	

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83
USGS Quadrangle: Unalakleet D-2 **Legal Description (MTRS):** K020S007W11
Waterbody Name:
Anadromous Waters Catalog Number: 333-60-10100-2130-3061
Geographic Comments:
Visit Comments:
Wildlife Comments:

Water Quality \ Stream Flow

Water Temp (C): 5.90 **DO (mg/L):** 12.65 **Conductivity (µS/cm):** 107 **Turbidity (NTU):** 3.11 **pH:** 7.67
Water Color: Clear **Thalweg Velocity (m/s)(ft/s):** 0.70 2.30

Stream Channel

Stream Gradient (%): 1 **Catchment Area(sq. km):** Does

Channel Dimensions (m):	Bank Full	Wetted
Width	4.4	3.0
Thalweg Depth	0.46	0.24

Dominant Substrate: Gravel
Subdominant Substrate 1: Sand/Silt/Clay
Subdominant Substrate 2: Cobble

Rosgen Class: C4 Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well-defined floodplains.

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5	Closed Tall Willow Shrub	4	Closed Low Willow Shrub	1.8
5 - 10	Closed Tall Willow Shrub	4	Open Black Spruce Forest	4
10 - 20	Open Black Spruce Forest	30	Open Black Spruce Forest	4
20 - 30	Open Black Spruce Forest	30	Open Black Spruce Forest	4

Key To Fish Sampling Methods

(PEF) Portable Electrofisher (VOG) Visual Observation, Ground

Fish Observations

Species: Dolly Varden **Life Stage:** juvenile/adult **Life History:** Unknown
Total Fish Count: 14 **Fish Measured:** 14 **Fork Lengths (mm)** **Min:** 85 **Max:** 177 **Mean:** 118 **Median:** 131
Sampling Method (No. of fish): PEF (14)
Comments:

Species: Dolly Varden **Life Stage:** juvenile **Life History:** Unknown
Total Fish Count: 4 **Fish Measured:** 4 **Fork Lengths (mm)** **Min:** 74 **Max:** 79 **Mean:** 76 **Median:** 76
Sampling Method (No. of fish): PEF (4)
Comments:

Species: coho salmon **Life Stage:** juvenile **Life History:** Anadromous
Total Fish Count: 7 **Fish Measured:** 2 **Fork Lengths (mm)** **Min:** 65 **Max:** 81 **Mean:** 73 **Median:** 73
Sampling Method (No. of fish): PEF (2) VOG (5)
Comments:

Species: slimy sculpin **Life Stage:** adult **Life History:** Resident
Total Fish Count: 12 **Fish Measured:** 12 **Fork Lengths (mm)** **Min:** 69 **Max:** 89 **Mean:** 77 **Median:** 79
Sampling Method (No. of fish): PEF (12)
Comments:

-continued-

Species: slimy sculpin **Life Stage:** juvenile/adult **Life History:** Resident
Total Fish Count: 202 **Fish Measured:** 2 **Fork Lengths (mm)** **Min:** 64 **Max:** 68 **Mean:** 66 **Median:** 66
Sampling Method (No. of fish): PEF (2) VOG (200)
Comments:

Instruments

Stream Gradient: handheld abney level
Stream Velocity: Orange Float
Turbidity: LaMotte 2020e turbidimeter
Water Quality: YSI 556
Channel Depths: graduated wading rod
Channel Widths: measuring tape
Electrofisher: Smith-Root LR-24

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FSW0915C020101.jp

FSW0915C020102.jp

Station Info

Observers: Jonathan Kirsch, Andrew Levi **Date/Time:** 08/21/2009 2:10 PM

Reach Coordinates (Upstream / Downstream)	Latitude	Longitude	/	Latitude	Latitude	Elevation NED (m)(ft):
	63.60809	-160.05370	/	63.60965	-160.05524	418 1371

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83
USGS Quadrangle: Unalakleet C-3 **Legal Description (MTRS):** K022S007W05
Waterbody Name:
Anadromous Waters Catalog Number: 333-60-10100-2400-3264
Geographic Comments:
Visit Comments:
Wildlife Comments: Shot a black bear in defense (did not find the carcass).

Water Quality \ Stream Flow

Water Temp (C): 7.26 **DO (mg/L):** 11.30 **Conductivity (µS/cm):** 88 **Turbidity (NTU):** 0.41 **pH:** 7.56
Water Color: Clear **Thalweg Velocity (m/s)(ft/s):** 0.55 1.80

Stream Channel

Stream Gradient (%): 0.8 **Catchment Area(sq. km):** Does

Channel Dimensions (m):	Bank Full	Wetted
Width	4.1	3.3
Thalweg Depth	0.45	0.30

Dominant Substrate: Gravel
Subdominant Substrate 1: Sand/Silt/Clay
Subdominant Substrate 2: Cobble

Rosgen Class: C4 Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well-defined floodplains.

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5	Closed Low Willow Shrub	2	Closed Low Willow Shrub	2
5 - 10	Closed Low Willow Shrub	2	Closed Low Willow Shrub	2
10 - 20	Closed Low Willow Shrub	2	Closed Low Willow Shrub	2
20 - 30	Closed Low Willow Shrub	2	Closed Low Willow Shrub	2

Key To Fish Sampling Methods

(PEF) Portable Electrofisher (VOG) Visual Observation, Ground

Fish Observations

Species: Dolly Varden **Life Stage:** juvenile/adult **Life History:** Unknown
Total Fish Count: 124 **Fish Measured:** 24 **Fork Lengths (mm)** **Min:** 84 **Max:** 151 **Mean:** 111 **Median:** 117
Sampling Method (No. of fish): PEF (54) VOG (70)
Comments:

Species: Dolly Varden **Life Stage:** juvenile **Life History:** Unknown
Total Fish Count: 3 **Fish Measured:** 3 **Fork Lengths (mm)** **Min:** 68 **Max:** 81 **Mean:** 76 **Median:** 74
Sampling Method (No. of fish): PEF (3)
Comments:

Species: coho salmon **Life Stage:** juvenile **Life History:** Anadromous
Total Fish Count: 10 **Fish Measured:** 4 **Fork Lengths (mm)** **Min:** 68 **Max:** 99 **Mean:** 83 **Median:** 83
Sampling Method (No. of fish): PEF (4) VOG (6)
Comments:

Species: slimy sculpin **Life Stage:** adult **Life History:** Resident
Total Fish Count: 3 **Fish Measured:** 3 **Fork Lengths (mm)** **Min:** 69 **Max:** 114 **Mean:** 87 **Median:** 91
Sampling Method (No. of fish): PEF (3)
Comments:

-continued-

Species: slimy sculpin **Life Stage:** juvenile/adult **Life History:** Resident
Total Fish Count: 115 **Fish Measured:** 15 **Fork Lengths (mm)** **Min:** 50 **Max:** 60 **Mean:** 55 **Median:** 55
Sampling Method (No. of fish): PEF (40) VOG (75)
Comments:

Species: no fish collected or observed **Life Stage:** not applicable **Life History:** Not Applicable
Total Fish Count: 0 **Fish Measured:** **Fork Lengths (mm)** **Min:** **Max:** **Mean:** **Median:**
Sampling Method (No. of fish): VOG (0)
Comments:

Instruments

Stream Gradient: handheld abney level
Stream Velocity: Orange Float
Turbidity: LaMotte 2020e turbidimeter
Water Quality: YSI 556
Channel Depths: graduated wading rod
Channel Widths: measuring tape
Electrofisher: Smith-Root LR-24

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FSW0915C030103.jp

FSW0915C030104.jp

FSW0915C030105.jp

Station Info

Observers: Jonathan Kirsch, Andrew Levi **Date/Time:** 08/21/2009 5:20 PM

Reach Coordinates (Upstream / Downstream)	Latitude	Longitude	/	Latitude	Latitude	Elevation NED (m)(ft): 399 1309
	63.51400	-159.95590	/	63.51430	-159.95555	

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83
USGS Quadrangle: Unalakleet C-2 **Legal Description (MTRS):** K023S007W11
Waterbody Name: Old Woman River
Anadromous Waters Catalog Number: 333-60-10100-2400
Geographic Comments:
Visit Comments:
Wildlife Comments:

Water Quality \ Stream Flow

Water Temp (C): 7.06 **DO (mg/L):** 12.00 **Conductivity (µS/cm):** 54 **Turbidity (NTU):** 0.24 **pH:** 7.54
Water Color: Clear **Thalweg Velocity (m/s)(ft/s):** 0.35 1.15

Stream Channel

Stream Gradient (%): 0.8 **Catchment Area(sq. km):** Does

Channel Dimensions (m):	Bank Full	Wetted
Width	4.2	4.0
Thalweg Depth	0.53	0.41

Dominant Substrate: Gravel
Subdominant Substrate 1: Sand/Silt/Clay
Subdominant Substrate 2: Cobble

Rosgen Class: E4 Low gradient, meandering riffle/pool stream with low width/depth ratio and little deposition. Very efficient and stable. High meander width ratio.

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5	Closed Low Willow Shrub	1.5	Closed Low Willow Shrub	3
5 - 10	Closed Low Willow Shrub	3	Closed Low Willow Shrub	3
10 - 20	Closed Low Willow Shrub	3	Closed Low Willow Shrub	3
20 - 30	Closed Low Willow Shrub	3	Closed Low Willow Shrub	3

Key To Fish Sampling Methods

(PEF) Portable Electrofisher (VOG) Visual Observation, Ground

Fish Observations

Species: Dolly Varden **Life Stage:** juvenile/adult **Life History:** Unknown
Total Fish Count: 89 **Fish Measured:** 14 **Fork Lengths (mm)** **Min:** 82 **Max:** 156 **Mean:** 106 **Median:** 119
Sampling Method (No. of fish): PEF (39) VOG (50)
Comments:

Species: Dolly Varden **Life Stage:** juvenile **Life History:** Unknown
Total Fish Count: 15 **Fish Measured:** 15 **Fork Lengths (mm)** **Min:** 44 **Max:** 73 **Mean:** 63 **Median:** 58
Sampling Method (No. of fish): PEF (15)
Comments:

Species: coho salmon **Life Stage:** juvenile **Life History:** Anadromous
Total Fish Count: 11 **Fish Measured:** 11 **Fork Lengths (mm)** **Min:** 34 **Max:** 60 **Mean:** 40 **Median:** 47
Sampling Method (No. of fish): PEF (11)
Comments:

Species: slimy sculpin **Life Stage:** juvenile/adult **Life History:** Resident
Total Fish Count: 63 **Fish Measured:** 3 **Fork Lengths (mm)** **Min:** 55 **Max:** 62 **Mean:** 57 **Median:** 58
Sampling Method (No. of fish): PEF (3) VOG (60)
Comments:

-continued-

Species: slimy sculpin **Life Stage:** juvenile **Life History:** Resident
Total Fish Count: 1 **Fish Measured:** 1 **Fork Lengths (mm)** **Min:** 48 **Max:** 48 **Mean:** 48 **Median:** 48
Sampling Method (No. of fish): PEF (1)
Comments:

Instruments

Stream Gradient: handheld abney level
Stream Velocity: Orange Float
Turbidity: LaMotte 2020e turbidimeter
Water Quality: YSI 556
Channel Depths: graduated wading rod
Channel Widths: measuring tape
Electrofisher: Smith-Root LR-24

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FSW0915C040108.jp

FSW0915C040109.jp

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FSW0915C040110.jp

Station Info

Observers: Cecil Rich, Gillian O'Doherty, Joe Buckwalter **Date/Time:** 08/22/2009 12:10 PM

Reach Coordinates (Upstream / Downstream)	Latitude	Longitude	/	Latitude	Latitude	Elevation NED (m)(ft): 45 148
	64.00067	-159.91212	/	63.98617	-159.93645	

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83
USGS Quadrangle: Norton Bay A-2 **Legal Description (MTRS):** K017S006W19
Waterbody Name: Unalakleet River
Anadromous Waters Catalog Number: 333-60-10100
Geographic Comments: Habitat transect located at N 63.97990, W 159.96291, ~ 2 km downstream of fish-collection reach.

Visit Comments: Cecil and Gillian made habitat observations and started fish collection on Aug 22. Cecil and Joe finished fish collection on Aug 23.

Wildlife Comments:

Water Quality \ Stream Flow

Water Temp (C): 8.67 **DO (mg/L):** 10.97 **Conductivity (µS/cm):** 105 **Turbidity (NTU):** 0.92 **pH:** 7.17
Water Color: Clear **Thalweg Velocity (m/s)(ft/s):** 0.91 2.98

Stream Channel

Stream Gradient (%): 0.2 **Catchment Area(sq. km):** Does

Channel Dimensions (m):	Bank Full	Wetted	
Width	58.0	34.0	**Subdominant Substrate 1:**
Thalweg Depth	2.85	1.00	**Subdominant Substrate 2:** Cobble

Dominant Substrate: Gravel

Rosgen Class: C4 Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well-defined floodplains.

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5				
5 - 10				
10 - 20				
20 - 30				

Key To Fish Sampling Methods

Total Electrofishing Time (s): 2899

(BEF) Boat-Mounted Electrofisher (VOB) Visual Observation, Boat

Fish Observations

Species: Dolly Varden **Life Stage:** adult **Life History:** Unknown
Total Fish Count: 25 **Fish Measured:** 1 **Fork Lengths (mm)** **Min:** 446 **Max:** 446 **Mean:** 446 **Median:** 446
Sampling Method (No. of fish): BEF (1) VOB (24) **Suspected Spawning:** Yes
Comments:

Species: Dolly Varden **Life Stage:** juvenile/adult **Life History:** Unknown
Total Fish Count: 3 **Fish Measured:** 3 **Fork Lengths (mm)** **Min:** 124 **Max:** 133 **Mean:** 129 **Median:** 128
Sampling Method (No. of fish): BEF (3)
Comments:

Species: Arctic grayling **Life Stage:** adult **Life History:** Resident
Total Fish Count: 4 **Fish Measured:** 2 **Fork Lengths (mm)** **Min:** 410 **Max:** 418 **Mean:** 414 **Median:** 414
Sampling Method (No. of fish): BEF (2) VOB (2)
Comments:

Species: Chinook salmon **Life Stage:** juvenile **Life History:** Anadromous
Total Fish Count: 4 **Fish Measured:** 4 **Fork Lengths (mm)** **Min:** 69 **Max:** 96 **Mean:** 82 **Median:** 82
Sampling Method (No. of fish): BEF (4)
Comments:

-continued-

Species: chum salmon **Life Stage:** adult spawning **Life History:** Anadromous
Total Fish Count: 30 **Fish Measured:** **Fork Lengths (mm)** **Min:** **Max:** **Mean:** **Median:**
Sampling Method (No. of fish): VOB (30)
Comments:

Species: coho salmon **Life Stage:** adult **Life History:** Anadromous
Total Fish Count: 233 **Fish Measured:** **Fork Lengths (mm)** **Min:** **Max:** **Mean:** **Median:**
Sampling Method (No. of fish): BEF (68) VOB (165)
Comments:

Species: coho salmon **Life Stage:** juvenile **Life History:** Anadromous
Total Fish Count: 66 **Fish Measured:** 31 **Fork Lengths (mm)** **Min:** 55 **Max:** 103 **Mean:** 73 **Median:** 79
Sampling Method (No. of fish): BEF (31) VOB (35)
Comments:

Species: pink salmon **Life Stage:** carcass **Life History:** Anadromous
Total Fish Count: 16 **Fish Measured:** **Fork Lengths (mm)** **Min:** **Max:** **Mean:** **Median:**
Sampling Method (No. of fish): VOB (16)
Comments:

Species: sockeye salmon **Life Stage:** adult spawning **Life History:** Anadromous
Total Fish Count: 20 **Fish Measured:** **Fork Lengths (mm)** **Min:** **Max:** **Mean:** **Median:**
Sampling Method (No. of fish): VOB (20)
Comments: Observed in a left-bank side-channel pool.

Species: slimy sculpin **Life Stage:** adult **Life History:** Resident
Total Fish Count: 8 **Fish Measured:** 8 **Fork Lengths (mm)** **Min:** 70 **Max:** 97 **Mean:** 78 **Median:** 83
Sampling Method (No. of fish): BEF (8)
Comments:

Species: slimy sculpin **Life Stage:** juvenile/adult **Life History:** Resident
Total Fish Count: 51 **Fish Measured:** 6 **Fork Lengths (mm)** **Min:** 51 **Max:** 65 **Mean:** 60 **Median:** 58
Sampling Method (No. of fish): BEF (6) VOB (45)
Comments:

Species: slimy sculpin **Life Stage:** juvenile **Life History:** Resident
Total Fish Count: 4 **Fish Measured:** 4 **Fork Lengths (mm)** **Min:** 35 **Max:** 42 **Mean:** 39 **Median:** 38
Sampling Method (No. of fish): BEF (4)
Comments:

Species: round whitefish **Life Stage:** adult **Life History:** Resident
Total Fish Count: 10 **Fish Measured:** 1 **Fork Lengths (mm)** **Min:** 373 **Max:** 373 **Mean:** 373 **Median:** 373
Sampling Method (No. of fish): BEF (1) VOB (9)
Comments:

Species: no fish collected or observed **Life Stage:** not applicable **Life History:** Not Applicable
Total Fish Count: 0 **Fish Measured:** **Fork Lengths (mm)** **Min:** **Max:** **Mean:** **Median:**
Sampling Method (No. of fish): BEF (0)
Comments:

Instruments

Stream Gradient:
Stream Velocity: Price AA meter
Turbidity: LaMotte 2020e turbidimeter
Water Quality: YSI 556
Channel Depths: handheld sonar depth finder
Channel Widths: handheld laser rangefinder
Electrofisher: Smith-Root GPP 2.5

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FSW0916A010828.jp

FSW0916A010829.jp

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FSW0916A010830.jp

Station Info

Observers: Joe Buckwalter, Jacob Ivanoff **Date/Time:** 08/22/2009 10:40 AM

Reach Coordinates (Upstream / Downstream) **Latitude** 63.44770 **Longitude** -161.45982 **Elevation NED (m)(ft):** 31 102

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83

USGS Quadrangle: Unalakleet B-5 **Legal Description (MTRS):** K023S014W31

Waterbody Name: Klikitarik River

Anadromous Waters Catalog Number:

Geographic Comments:

Visit Comments: Dry channel--did not land.

Wildlife Comments:

Water Quality \ Stream Flow

Water Temp (C): **DO (mg/L):** **Conductivity (µS/cm):** **Turbidity (NTU):** **pH:**

Water Color: **Thalweg Velocity (m/s)(ft/s):**

Stream Channel

Stream Gradient (%): **Catchment Area(sq. km):** Does

Channel Dimensions (m): **Bank Full Width** **Wetted Thalweg Depth**

Dominant Substrate:

Subdominant Substrate 1:

Subdominant Substrate 2:

Rosgen Class:

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5				
5 - 10				
10 - 20				
20 - 30				

Key To Fish Sampling Methods

(NON) None

Fish Observations

Species: no collection effort **Life Stage:** not applicable **Life History:** Not Applicable

Total Fish Count: 0 **Fish Measured:** **Fork Lengths (mm)** **Min:** **Max:** **Mean:** **Median:**

Sampling Method (No. of fish): NON (0)

Comments:

Instruments

Stream Gradient: **Channel Depths:**

Stream Velocity: **Channel Widths:**

Turbidity: **Electrofisher:**

Water Quality:

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FSW0916B010438.jp

FSW0916B010439.jp

Station Info

Observers: Joe Buckwalter, Jacob Ivanoff **Date/Time:** 08/22/2009 12:17 PM

Reach Coordinates (Upstream / Downstream)	Latitude	Longitude	/	Latitude	Latitude	Elevation NED (m)(ft): 166 545
	63.31697	-161.21717	/	63.32948	-161.20616	

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83
USGS Quadrangle: Unalakleet B-5 **Legal Description (MTRS):** K025S013W18
Waterbody Name: Golsovia River
Anadromous Waters Catalog Number: 333-60-10300
Geographic Comments:
Visit Comments: Turbidity meter broken--water was clear.
Wildlife Comments: Bear & wolf tracks.

Water Quality \ Stream Flow

Water Temp (C): 7.91 **DO (mg/L):** 11.14 **Conductivity (µS/cm):** 55 **Turbidity (NTU):** **pH:** 7.67
Water Color: Clear **Thalweg Velocity (m/s)(ft/s):** 0.51 1.67

Stream Channel

Stream Gradient (%): 0.5 **Catchment Area(sq. km):** Does

Channel Dimensions (m):	Bank Full	Wetted	
Width	30.0	15.4	**Subdominant Substrate 1:** Boulder
Thalweg Depth	1.30	0.60	**Subdominant Substrate 2:** Gravel

Dominant Substrate: Cobble

Rosgen Class: C3 Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well-defined floodplains.

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5	Open Tall Willow Shrub	4	Unvegetated	
5 - 10	Open Tall Willow Shrub	4	Unvegetated	
10 - 20	Open Tall Willow Shrub	4	Closed Tall Willow Shrub	4
20 - 30	Open White Spruce Forest	6	Closed Balsam Poplar-White Spruce Forest	15

Key To Fish Sampling Methods

Total Electrofishing Time (s): 2578

(BEF) Boat-Mounted Electrofisher (VOB) Visual Observation, Boat

Fish Observations

Species: Dolly Varden **Life Stage:** adult spawning **Life History:** Unknown
Total Fish Count: 13 **Fish Measured:** 4 **Fork Lengths (mm)** **Min:** 443 **Max:** 473 **Mean:** 452 **Median:** 458
Sampling Method (No. of fish): BEF (7) VOB (6)
Comments: On redds in spawning colors.

Species: Dolly Varden **Life Stage:** juvenile/adult **Life History:** Unknown
Total Fish Count: 12 **Fish Measured:** 12 **Fork Lengths (mm)** **Min:** 90 **Max:** 176 **Mean:** 126 **Median:** 133
Sampling Method (No. of fish): BEF (12)
Comments:

Species: Dolly Varden **Life Stage:** juvenile **Life History:** Unknown
Total Fish Count: 26 **Fish Measured:** 2 **Fork Lengths (mm)** **Min:** 65 **Max:** 69 **Mean:** 67 **Median:** 67
Sampling Method (No. of fish): BEF (2) VOB (24)
Comments:

Species: salmonid-unspecified **Life Stage:** juvenile **Life History:** Unknown
Total Fish Count: 18 **Fish Measured:** **Fork Lengths (mm)** **Min:** **Max:** **Mean:** **Median:**
Sampling Method (No. of fish): VOB (18)
Comments: 50-60 mm; probably Chinook or coho.

-continued-

Species: Chinook salmon **Life Stage:** juvenile **Life History:** Anadromous
Total Fish Count: 12 **Fish Measured:** 9 **Fork Lengths (mm)** **Min:** 57 **Max:** 71 **Mean:** 66 **Median:** 64
Sampling Method (No. of fish): BEF (9) VOB (3)
Comments:

Species: chum salmon **Life Stage:** adult spawning **Life History:** Anadromous
Total Fish Count: 2 **Fish Measured:** **Fork Lengths (mm)** **Min:** **Max:** **Mean:** **Median:**
Sampling Method (No. of fish): VOB (2)
Comments: On redds.

Species: coho salmon **Life Stage:** adult **Life History:** Anadromous
Total Fish Count: 3 **Fish Measured:** **Fork Lengths (mm)** **Min:** **Max:** **Mean:** **Median:**
Sampling Method (No. of fish): VOB (3) **Suspected Spawning:** Yes
Comments:

Species: coho salmon **Life Stage:** juvenile **Life History:** Anadromous
Total Fish Count: 3 **Fish Measured:** 2 **Fork Lengths (mm)** **Min:** 85 **Max:** 88 **Mean:** 86 **Median:** 86
Sampling Method (No. of fish): BEF (2) VOB (1)
Comments:

Species: pink salmon **Life Stage:** adult spawning **Life History:** Anadromous
Total Fish Count: 2 **Fish Measured:** **Fork Lengths (mm)** **Min:** **Max:** **Mean:** **Median:**
Sampling Method (No. of fish): VOB (2)
Comments: On redd.

Species: pink salmon **Life Stage:** carcass **Life History:** Anadromous
Total Fish Count: 291 **Fish Measured:** **Fork Lengths (mm)** **Min:** **Max:** **Mean:** **Median:**
Sampling Method (No. of fish): VOB (291) **Suspected Spawning:** Yes
Comments: Redds everywhere.

Species: slimy sculpin **Life Stage:** adult **Life History:** Resident
Total Fish Count: 8 **Fish Measured:** 8 **Fork Lengths (mm)** **Min:** 72 **Max:** 93 **Mean:** 80 **Median:** 82
Sampling Method (No. of fish): BEF (8)
Comments:

Species: slimy sculpin **Life Stage:** juvenile/adult **Life History:** Resident
Total Fish Count: 124 **Fish Measured:** 15 **Fork Lengths (mm)** **Min:** 50 **Max:** 68 **Mean:** 61 **Median:** 59
Sampling Method (No. of fish): BEF (108) VOB (16)
Comments:

Species: slimy sculpin **Life Stage:** juvenile **Life History:** Resident
Total Fish Count: 8 **Fish Measured:** 8 **Fork Lengths (mm)** **Min:** 36 **Max:** 49 **Mean:** 39 **Median:** 42
Sampling Method (No. of fish): BEF (8)
Comments:

Instruments

Stream Gradient:

Stream Velocity: Price AA meter

Turbidity:

Water Quality: YSI 556

Channel Depths: graduated wading rod

Channel Widths: measuring tape

Electrofisher: Smith-Root GPP 2.5

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FSW0916B020440.jp

FSW0916B020441.jp

FSW0916B020442.jp

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FSW0916B020443.jp

Station Info

Observers: Jonathan Kirsch, Andrew Levi **Date/Time:** 08/22/2009 9:32 AM

Reach Coordinates (Upstream / Downstream)	Latitude	Longitude	Elevation NED (m)(ft): 142 466
	64.13080	-159.43996	

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83
USGS Quadrangle: Norton Bay A-1 **Legal Description (MTRS):** K016S004W03
Waterbody Name:
Anadromous Waters Catalog Number:
Geographic Comments:
Visit Comments: Mud hole with no spawning habitat and poor rearing habitat.
Wildlife Comments:

Water Quality \ Stream Flow

Water Temp (C): **DO (mg/L):** **Conductivity (µS/cm):** **Turbidity (NTU):** **pH:**
Water Color: **Thalweg Velocity (m/s)(ft/s):**

Stream Channel

Stream Gradient (%): **Catchment Area(sq. km):** Does

Channel Dimensions (m):	Bank Full Width	Wetted	Dominant Substrate:
			Subdominant Substrate 1:
Thalweg Depth			Subdominant Substrate 2:

Rosgen Class:

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5				
5 - 10				
10 - 20				
20 - 30				

Key To Fish Sampling Methods

(NON) None

Fish Observations

Species: no collection effort **Life Stage:** not applicable **Life History:** Not Applicable

Total Fish Count: 0	Fish Measured:	Fork Lengths (mm)	Min:	Max:	Mean:	Median:

Sampling Method (No. of fish): NON (0)
Comments:

Instruments

Stream Gradient: **Channel Depths:**
Stream Velocity: **Channel Widths:**
Turbidity: **Electrofisher:**
Water Quality:

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FSW0916C010111.jp

FSW0916C010112.jp

Station Info

Observers: Jonathan Kirsch, Andrew Levi **Date/Time:** 08/22/2009 10:32 AM

Reach Coordinates (Upstream / Downstream)	Latitude	Longitude	/	Latitude	Latitude	Elevation NED (m)(ft): 361 1184
	64.30669	-159.27330	/	64.30630	-159.27747	

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83
USGS Quadrangle: Norton Bay B-1 **Legal Description (MTRS):** K014S003W04
Waterbody Name: Unalakleet River
Anadromous Waters Catalog Number:
Geographic Comments:
Visit Comments: Nutrient-poor stream lined with large cobbles and very few back-water/slow-water habitats.
Wildlife Comments:

Water Quality \ Stream Flow

Water Temp (C): 4.58 **DO (mg/L):** 12.39 **Conductivity (µS/cm):** 165 **Turbidity (NTU):** 0.12 **pH:** 7.60
Water Color: Clear **Thalweg Velocity (m/s)(ft/s):** 0.50 1.64

Stream Channel

Stream Gradient (%): 1.2 **Catchment Area(sq. km):** Does

Channel Dimensions (m):	Bank Full	Wetted
Width	10.5	6.7
Thalweg Depth	0.55	0.40

Dominant Substrate: Cobble
Subdominant Substrate 1: Sand/Silt/Clay
Subdominant Substrate 2: Gravel

Rosgen Class: C3 Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well-defined floodplains.

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5	Closed Tall Willow Shrub	0.8	Closed Tall Willow Shrub	2
5 - 10	Closed Tall Willow Shrub	0.8	Closed Tall Willow Shrub	2
10 - 20	Closed Tall Willow Shrub	0.8	Closed Tall Willow Shrub	2
20 - 30	Closed Tall Willow Shrub	0.8	Closed Tall Willow Shrub	2

Key To Fish Sampling Methods

(PEF) Portable Electrofisher (VOG) Visual Observation, Ground

Fish Observations

Species: Dolly Varden **Life Stage:** juvenile/adult **Life History:** Unknown
Total Fish Count: 27 **Fish Measured:** 12 **Fork Lengths (mm)** **Min:** 83 **Max:** 220 **Mean:** 111 **Median:** 151
Sampling Method (No. of fish): PEF (27)
Comments:

Species: Dolly Varden **Life Stage:** juvenile **Life History:** Unknown
Total Fish Count: 15 **Fish Measured:** 15 **Fork Lengths (mm)** **Min:** 36 **Max:** 75 **Mean:** 63 **Median:** 55
Sampling Method (No. of fish): PEF (15)
Comments:

Species: slimy sculpin **Life Stage:** juvenile/adult **Life History:** Resident
Total Fish Count: 4 **Fish Measured:** **Fork Lengths (mm)** **Min:** **Max:** **Mean:** **Median:**
Sampling Method (No. of fish): VOG (4)
Comments:

Instruments

Stream Gradient: handheld abney level
Stream Velocity: Orange Float
Turbidity: LaMotte 2020e turbidimeter
Water Quality: YSI 556
Channel Depths: graduated wading rod
Channel Widths: measuring tape
Electrofisher: Smith-Root LR-24

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FSW0916C020113.jp

FSW0916C020114.jp

FSW0916C020115.jp

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FSW0916C020116.jp

Station Info

Observers: Jonathan Kirsch, Andrew Levi **Date/Time:** 08/22/2009 12:33 PM

Reach Coordinates (Upstream / Downstream)	Latitude	Longitude	/	Latitude	Latitude	Elevation NED (m)(ft): 213 699
	64.13879	-159.59167	/	64.13705	-159.59398	

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83
USGS Quadrangle: Norton Bay A-2 **Legal Description (MTRS):** K015S005W35
Waterbody Name:
Anadromous Waters Catalog Number:
Geographic Comments:
Visit Comments:
Wildlife Comments:

Water Quality \ Stream Flow

Water Temp (C): 6.39 **DO (mg/L):** 11.87 **Conductivity (µS/cm):** 157 **Turbidity (NTU):** 0.25 **pH:** 7.75
Water Color: Clear **Thalweg Velocity (m/s)(ft/s):** 0.60 1.97

Stream Channel

Stream Gradient (%): 1 **Catchment Area(sq. km):** Does

Channel Dimensions (m):	Bank Full	Wetted
Width	7.3	6.5
Thalweg Depth	0.45	0.32

Dominant Substrate: Gravel
Subdominant Substrate 1: Sand/Silt/Clay
Subdominant Substrate 2: Cobble

Rosgen Class: C4 Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well-defined floodplains.

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5	Closed Low Willow Shrub	2	Closed Spruce-Paper Birch Forest	25
5 - 10	Open Black Spruce Forest	25	Closed Spruce-Paper Birch Forest	25
10 - 20	Open Black Spruce Forest	25	Closed Spruce-Paper Birch Forest	25
20 - 30	Open Black Spruce Forest	25	Closed Spruce-Paper Birch Forest	25

Key To Fish Sampling Methods

(PEF) Portable Electrofisher (VOG) Visual Observation, Ground

Fish Observations

Species: Dolly Varden **Life Stage:** adult **Life History:** Unknown
Total Fish Count: 17 **Fish Measured:** 2 **Fork Lengths (mm)** **Min:** 350 **Max:** 490 **Mean:** 420 **Median:** 420
Sampling Method (No. of fish): PEF (2) VOG (15)
Comments:

Species: Dolly Varden **Life Stage:** juvenile/adult **Life History:** Unknown
Total Fish Count: 7 **Fish Measured:** 7 **Fork Lengths (mm)** **Min:** 82 **Max:** 154 **Mean:** 105 **Median:** 118
Sampling Method (No. of fish): PEF (7)
Comments:

Species: Dolly Varden **Life Stage:** juvenile **Life History:** Unknown
Total Fish Count: 7 **Fish Measured:** 7 **Fork Lengths (mm)** **Min:** 41 **Max:** 72 **Mean:** 51 **Median:** 56
Sampling Method (No. of fish): PEF (7)
Comments:

Species: slimy sculpin **Life Stage:** adult **Life History:** Resident
Total Fish Count: 4 **Fish Measured:** 4 **Fork Lengths (mm)** **Min:** 74 **Max:** 89 **Mean:** 82 **Median:** 81
Sampling Method (No. of fish): PEF (4)
Comments:

-continued-

Species: slimy sculpin **Life Stage:** juvenile/adult **Life History:** Resident
Total Fish Count: 9 **Fish Measured:** 9 **Fork Lengths (mm)** **Min:** 55 **Max:** 67 **Mean:** 61 **Median:** 61
Sampling Method (No. of fish): PEF (9)
Comments:

Instruments

Stream Gradient: handheld abney level
Stream Velocity: Orange Float
Turbidity: LaMotte 2020e turbidimeter
Water Quality: YSI 556
Channel Depths: graduated wading rod
Channel Widths: measuring tape
Electrofisher: Smith-Root LR-24

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FSW0916C030117.jp

FSW0916C030118.jp

FSW0916C030119.jp

FSW0916C030120.jp

Station Info

Observers: Jonathan Kirsch, Andrew Levi **Date/Time:** 08/22/2009 2:25 PM

Reach Coordinates (Upstream / Downstream)	Latitude	Longitude	/	Latitude	Latitude	Elevation NED (m)(ft):
	63.96245	-159.53210	/	63.96286	-159.53364	312 1024

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83
USGS Quadrangle: Unalakleet D-2 **Legal Description (MTRS):** K018S004W06
Waterbody Name: Tenmile River
Anadromous Waters Catalog Number: 333-60-10100-2480
Geographic Comments:
Visit Comments:
Wildlife Comments:

Water Quality \ Stream Flow

Water Temp (C): 5.66 **DO (mg/L):** 12.19 **Conductivity (µS/cm):** 62 **Turbidity (NTU):** 1.34 **pH:** 7.43
Water Color: Clear **Thalweg Velocity (m/s)(ft/s):** 0.61 2.00

Stream Channel

Stream Gradient (%): 0.5 **Catchment Area(sq. km):** Does

Channel Dimensions (m):	Bank Full	Wetted
Width	3.6	3.0
Thalweg Depth	0.57	0.40

Dominant Substrate: Gravel
Subdominant Substrate 1: Cobble
Subdominant Substrate 2: Sand/Silt/Clay

Rosgen Class: E4 Low gradient, meandering riffle/pool stream with low width/depth ratio and little deposition. Very efficient and stable. High meander width ratio.

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5	Open Tall Willow Shrub	2.5	Open Tall Willow Shrub	2.5
5 - 10	Open Tall Willow Shrub	2.5	Open Tall Willow Shrub	2.5
10 - 20	Open Tall Willow Shrub	2.5	Open Tall Willow Shrub	2.5
20 - 30	Open Tall Willow Shrub	2.5	Open Tall Willow Shrub	2.5

Key To Fish Sampling Methods

(PEF) Portable Electrofisher (VOG) Visual Observation, Ground

Fish Observations

Species: Dolly Varden **Life Stage:** adult **Life History:** Unknown
Total Fish Count: 2 **Fish Measured:** **Fork Lengths (mm)** **Min:** **Max:** **Mean:** **Median:**
Sampling Method (No. of fish): VOG (2)
Comments:

Species: Dolly Varden **Life Stage:** juvenile/adult **Life History:** Unknown
Total Fish Count: 4 **Fish Measured:** 4 **Fork Lengths (mm)** **Min:** 82 **Max:** 110 **Mean:** 93 **Median:** 96
Sampling Method (No. of fish): PEF (4)
Comments:

Species: Dolly Varden **Life Stage:** juvenile **Life History:** Unknown
Total Fish Count: 8 **Fish Measured:** 8 **Fork Lengths (mm)** **Min:** 45 **Max:** 80 **Mean:** 64 **Median:** 62
Sampling Method (No. of fish): PEF (8)
Comments:

Species: coho salmon **Life Stage:** juvenile **Life History:** Anadromous
Total Fish Count: 35 **Fish Measured:** 15 **Fork Lengths (mm)** **Min:** 31 **Max:** 42 **Mean:** 37 **Median:** 36
Sampling Method (No. of fish): PEF (15) VOG (20)
Comments:

-continued-

Species: slimy sculpin **Life Stage:** adult **Life History:** Resident
Total Fish Count: 1 **Fish Measured:** 1 **Fork Lengths (mm)** **Min:** 77 **Max:** 77 **Mean:** 77 **Median:** 77
Sampling Method (No. of fish): PEF (1)
Comments:

Species: slimy sculpin **Life Stage:** juvenile/adult **Life History:** Resident
Total Fish Count: 5 **Fish Measured:** 5 **Fork Lengths (mm)** **Min:** 51 **Max:** 64 **Mean:** 56 **Median:** 57
Sampling Method (No. of fish): PEF (5)
Comments:

Species: slimy sculpin **Life Stage:** juvenile **Life History:** Resident
Total Fish Count: 3 **Fish Measured:** 3 **Fork Lengths (mm)** **Min:** 39 **Max:** 46 **Mean:** 43 **Median:** 42
Sampling Method (No. of fish): PEF (3)
Comments:

Species: no fish collected or observed **Life Stage:** not applicable **Life History:** Not Applicable
Total Fish Count: 0 **Fish Measured:** **Fork Lengths (mm)** **Min:** **Max:** **Mean:** **Median:**
Sampling Method (No. of fish): VOG (0)
Comments:

Instruments

Stream Gradient: handheld abney level
Stream Velocity: Orange Float
Turbidity: LaMotte 2020e turbidimeter
Water Quality: YSI 556
Channel Depths: graduated wading rod
Channel Widths: measuring tape
Electrofisher: Smith-Root LR-24

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FSW0916C040121.jp

FSW0916C040122.jp

FSW0916C040123.jp

Station Info

Observers: Jonathan Kirsch, Andrew Levi **Date/Time:** 08/22/2009 4:26 PM

Reach Coordinates (Upstream / Downstream)	Latitude	Longitude	/	Latitude	Latitude	Elevation NED (m)(ft): 113 371
	64.01270	-160.15425		64.01247	-160.15105	

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83
USGS Quadrangle: Norton Bay A-3 **Legal Description (MTRS):** K017S008W13
Waterbody Name:
Anadromous Waters Catalog Number: 333-60-10100-2291
Geographic Comments:
Visit Comments:
Wildlife Comments:

Water Quality \ Stream Flow

Water Temp (C): 7.98 **DO (mg/L):** 11.60 **Conductivity (µS/cm):** 98 **Turbidity (NTU):** 0.94 **pH:** 7.40
Water Color: Clear **Thalweg Velocity (m/s)(ft/s):** 0.55 1.80

Stream Channel

Stream Gradient (%): 0.4 **Catchment Area(sq. km):** Does

Channel Dimensions (m):	Bank Full	Wetted
Width	6.3	4.8
Thalweg Depth	0.53	0.26

Dominant Substrate: Gravel
Subdominant Substrate 1: Sand/Silt/Clay
Subdominant Substrate 2: Cobble

Rosgen Class: C4 Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well-defined floodplains.

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5	Open Black Spruce Forest	25	Open Black Spruce Forest	15
5 - 10	Open Black Spruce Forest	25	Open Black Spruce Forest	15
10 - 20	Open Black Spruce Forest	25	Open Black Spruce Forest	15
20 - 30	Open Black Spruce Forest	25	Open Black Spruce Forest	15

Key To Fish Sampling Methods

(PEF) Portable Electrofisher (VOG) Visual Observation, Ground

Fish Observations

Species: coho salmon **Life Stage:** juvenile **Life History:** Anadromous
Total Fish Count: 28 **Fish Measured:** 3 **Fork Lengths (mm)** **Min:** 49 **Max:** 63 **Mean:** 55 **Median:** 56
Sampling Method (No. of fish): PEF (18) VOG (10)
Comments:

Species: slimy sculpin **Life Stage:** juvenile/adult **Life History:** Resident
Total Fish Count: 11 **Fish Measured:** 1 **Fork Lengths (mm)** **Min:** 63 **Max:** 63 **Mean:** 63 **Median:** 63
Sampling Method (No. of fish): PEF (1) VOG (10)
Comments:

Species: slimy sculpin **Life Stage:** juvenile **Life History:** Resident
Total Fish Count: 1 **Fish Measured:** 1 **Fork Lengths (mm)** **Min:** 34 **Max:** 34 **Mean:** 34 **Median:** 34
Sampling Method (No. of fish): PEF (1)
Comments:

Instruments

Stream Gradient: handheld abney level
Stream Velocity: Orange Float
Turbidity: LaMotte 2020e turbidimeter
Water Quality: YSI 556
Channel Depths: graduated wading rod
Channel Widths: measuring tape
Electrofisher: Smith-Root LR-24

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FSW0916C050126.jp

FSW0916C050127.jp

Station Info

Observers: Jonathan Kirsch, Joe Buckwalter, Cecil Rich, Gillian O'Doherty **Date/Time:** 08/23/2009 4:30 PM

Reach Coordinates (Upstream / Downstream)	Latitude	Longitude	/	Latitude	Latitude	Elevation NED (m)(ft): 132 433
	64.59684	-160.42708	/	64.55703	-160.46409	

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83
USGS Quadrangle: Norton Bay C-3 **Legal Description (MTRS):** K010S009W26
Waterbody Name: Shaktoolik River
Anadromous Waters Catalog Number: 333-50-10100
Geographic Comments:
Visit Comments: Cecil and Joe completed most of the habitat assessment on 8/23--then Jonathan and Gillian did the fish collection on 8/24.
Wildlife Comments: Bear & moose tracks.

Water Quality \ Stream Flow

Water Temp (C): 9.05 **DO (mg/L):** 11.63 **Conductivity (µS/cm):** 117 **Turbidity (NTU):** 0.09 **pH:** 7.52
Water Color: Clear **Thalweg Velocity (m/s)(ft/s):** 0.85 2.79

Stream Channel

Stream Gradient (%): 0.5 **Catchment Area(sq. km):** Does

Channel Dimensions (m):	Bank Full	Wetted	Dominant Substrate: Gravel
Width	62.0	34.0	Subdominant Substrate 1:
Thalweg Depth	4.50	3.10	Subdominant Substrate 2: Cobble

Rosgen Class: C4 Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well-defined floodplains.

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5	Bluejoint-Shrub	1	Closed Tall Willow Shrub	7
5 - 10	Bluejoint-Shrub	1	Closed Tall Willow Shrub	7
10 - 20	Open White Spruce Forest	14	Closed Tall Willow Shrub	7
20 - 30	Open White Spruce Forest	14	Closed Tall Willow Shrub	7

Key To Fish Sampling Methods

Total Electrofishing Time (s): 4071

(BEF) Boat-Mounted Electrofisher (VOB) Visual Observation, Boat

Fish Observations

Species: Dolly Varden **Life Stage:** adult **Life History:** Unknown
Total Fish Count: 11 **Fish Measured:** 1 **Fork Lengths (mm)** **Min:** 423 **Max:** 423 **Mean:** 423 **Median:** 423
Sampling Method (No. of fish): BEF (1) VOB (10)
Comments:

Species: Dolly Varden **Life Stage:** juvenile/adult **Life History:** Unknown
Total Fish Count: 15 **Fish Measured:** 2 **Fork Lengths (mm)** **Min:** 119 **Max:** 125 **Mean:** 122 **Median:** 122
Sampling Method (No. of fish): BEF (2) VOB (13)
Comments:

Species: Arctic grayling **Life Stage:** adult **Life History:** Resident
Total Fish Count: 1 **Fish Measured:** 1 **Fork Lengths (mm)** **Min:** 396 **Max:** 396 **Mean:** 396 **Median:** 396
Sampling Method (No. of fish): BEF (1)
Comments:

Species: Arctic grayling **Life Stage:** juvenile **Life History:** Resident
Total Fish Count: 3 **Fish Measured:** 3 **Fork Lengths (mm)** **Min:** 71 **Max:** 87 **Mean:** 76 **Median:** 79
Sampling Method (No. of fish): BEF (3)
Comments:

-continued-

Species: coho salmon **Life Stage:** adult **Life History:** Anadromous
Total Fish Count: 111 **Fish Measured:** **Fork Lengths (mm)** **Min:** **Max:** **Mean:** **Median:**
Sampling Method (No. of fish): BEF (46) VOB (65)
Comments:

Species: coho salmon **Life Stage:** juvenile **Life History:** Anadromous
Total Fish Count: 5 **Fish Measured:** 5 **Fork Lengths (mm)** **Min:** 68 **Max:** 80 **Mean:** 71 **Median:** 74
Sampling Method (No. of fish): BEF (5)
Comments:

Species: slimy sculpin **Life Stage:** adult **Life History:** Resident
Total Fish Count: 1 **Fish Measured:** 1 **Fork Lengths (mm)** **Min:** 75 **Max:** 75 **Mean:** 75 **Median:** 75
Sampling Method (No. of fish): BEF (1)
Comments:

Species: slimy sculpin **Life Stage:** juvenile/adult **Life History:** Resident
Total Fish Count: 79 **Fish Measured:** 4 **Fork Lengths (mm)** **Min:** 51 **Max:** 67 **Mean:** 56 **Median:** 59
Sampling Method (No. of fish): BEF (56) VOB (23)
Comments:

Species: slimy sculpin **Life Stage:** juvenile **Life History:** Resident
Total Fish Count: 1 **Fish Measured:** 1 **Fork Lengths (mm)** **Min:** 16 **Max:** 16 **Mean:** 16 **Median:** 16
Sampling Method (No. of fish): BEF (1)
Comments:

Species: round whitefish **Life Stage:** adult **Life History:** Resident
Total Fish Count: 1 **Fish Measured:** 1 **Fork Lengths (mm)** **Min:** 465 **Max:** 465 **Mean:** 465 **Median:** 465
Sampling Method (No. of fish): BEF (1)
Comments:

Instruments

Stream Gradient:

Stream Velocity: Orange Float

Turbidity: LaMotte 2020e turbidimeter

Water Quality: YSI 556

Channel Depths: handheld sonar depth finder

Channel Widths: handheld laser rangefinder

Electrofisher: Smith-Root GPP 2.5

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FSW0917A010831.jp

FSW0917A010832.jp

FSW0917A010833.jp

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FSW0917A010834.jp

FSW0917A010835.jp

Station Info

Observers: Tim Sundlov, Jacob Ivanoff **Date/Time:** 08/23/2009 10:12 AM

Reach Coordinates (Upstream / Downstream)	Latitude	Longitude	/	Latitude	Latitude	Elevation NED (m)(ft): 96 315
	64.16770	-160.56659		64.16158	-160.59778	

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83
USGS Quadrangle: Norton Bay A-4 **Legal Description (MTRS):** K015S010W24
Waterbody Name: Egavik Creek
Anadromous Waters Catalog Number: 333-50-10700
Geographic Comments: Started downstream of waypoint because of log jams.

Visit Comments: Turbidity meter not working.

Wildlife Comments: Peregrine falcon nest just upstream of starting point on bluff on the left side of the river.

Water Quality \ Stream Flow

Water Temp (C): 6.27 **DO (mg/L):** 11.26 **Conductivity (µS/cm):** 56 **Turbidity (NTU):** **pH:** 7.41
Water Color: Clear **Thalweg Velocity (m/s)(ft/s):** 0.74 2.43

Stream Channel

Stream Gradient (%): 1 **Catchment Area(sq. km):** Does

Channel Dimensions (m):	Bank Full	Wetted	
Width	23.8	15.1	**Subdominant Substrate 1:** Boulder
Thalweg Depth	0.90	0.40	**Subdominant Substrate 2:** Cobble

Dominant Substrate: Gravel

Rosgen Class: C4 Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well-defined floodplains.

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5	Open Low Willow Shrub	3	Open Low Willow Shrub	3
5 - 10	Open Low Willow Shrub	3	Open Low Willow Shrub	3
10 - 20	Open Black Spruce Forest	7	Open Black Spruce Forest	7
20 - 30	Open Black Spruce Forest	7	Open Black Spruce Forest	7

Key To Fish Sampling Methods

Total Electrofishing Time (s): 2653

(BEF) Boat-Mounted Electrofisher
(DIP) Dip Net
(VOB) Visual Observation, Boat

Fish Observations

Species: Dolly Varden **Life Stage:** adult spawning **Life History:** Unknown
Total Fish Count: 41 **Fish Measured:** 13 **Fork Lengths (mm)** **Min:** 250 **Max:** 670 **Mean:** 438 **Median:** 460
Sampling Method (No. of fish): BEF (28) VOB (13)
Comments: These dollies are likely anadromous, based on their large size, proximity to saltwater, and low food availability a

Species: Dolly Varden **Life Stage:** juvenile/adult **Life History:** Unknown
Total Fish Count: 13 **Fish Measured:** 13 **Fork Lengths (mm)** **Min:** 82 **Max:** 173 **Mean:** 117 **Median:** 127
Sampling Method (No. of fish): BEF (13)
Comments:

Species: Dolly Varden **Life Stage:** juvenile **Life History:** Unknown
Total Fish Count: 27 **Fish Measured:** 21 **Fork Lengths (mm)** **Min:** 40 **Max:** 66 **Mean:** 53 **Median:** 53
Sampling Method (No. of fish): BEF (17) DIP (4) VOB (6)
Comments:

Species: coho salmon **Life Stage:** adult **Life History:** Anadromous
Total Fish Count: 7 **Fish Measured:** **Fork Lengths (mm)** **Min:** **Max:** **Mean:** **Median:**
Sampling Method (No. of fish): VOB (7)
Comments:

-continued-

Species: coho salmon **Life Stage:** juvenile **Life History:** Anadromous
Total Fish Count: 36 **Fish Measured:** 16 **Fork Lengths (mm)** **Min:** 40 **Max:** 58 **Mean:** 48 **Median:** 49
Sampling Method (No. of fish): BEF (5) DIP (11) VOB (20)
Comments:

Species: slimy sculpin **Life Stage:** adult **Life History:** Resident
Total Fish Count: 11 **Fish Measured:** 11 **Fork Lengths (mm)** **Min:** 69 **Max:** 76 **Mean:** 72 **Median:** 72
Sampling Method (No. of fish): BEF (11)
Comments:

Species: slimy sculpin **Life Stage:** juvenile/adult **Life History:** Resident
Total Fish Count: 40 **Fish Measured:** 14 **Fork Lengths (mm)** **Min:** 52 **Max:** 68 **Mean:** 59 **Median:** 60
Sampling Method (No. of fish): BEF (18) VOB (22)
Comments:

Species: slimy sculpin **Life Stage:** juvenile **Life History:** Resident
Total Fish Count: 3 **Fish Measured:** 3 **Fork Lengths (mm)** **Min:** 42 **Max:** 49 **Mean:** 46 **Median:** 45
Sampling Method (No. of fish): BEF (3)
Comments:

Instruments

Stream Gradient:
Stream Velocity: Price AA meter
Turbidity:
Water Quality: YSI 556
Channel Depths: graduated wading rod
Channel Widths: measuring tape
Electrofisher: Smith-Root GPP 2.5

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FSW0917B010446.jp

FSW0917B010447.jp

FSW0917B010449.jp

FSW0917B010457.jp

FSW0917B010466.jp

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FSW0917B010468.jp

FSW0917B010469.jp

Station Info

Observers: Jonathan Kirsch, Daniel Reed **Date/Time:** 08/23/2009 11:23 AM

Reach Coordinates (Upstream / Downstream)	Latitude	Longitude	/	Latitude	Latitude	Elevation NED (m)(ft): 241 791
	64.32097	-160.19292	/	64.31989	-160.19264	

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83
USGS Quadrangle: Norton Bay B-3 **Legal Description (MTRS):** K013S008W35
Waterbody Name:
Anadromous Waters Catalog Number:
Geographic Comments:
Visit Comments:
Wildlife Comments:

Water Quality \ Stream Flow

Water Temp (C): 3.88 **DO (mg/L):** 12.90 **Conductivity (µS/cm):** 69 **Turbidity (NTU):** 0.75 **pH:** 7.45
Water Color: Clear **Thalweg Velocity (m/s)(ft/s):** 0.77 2.53

Stream Channel

Stream Gradient (%): 0.8 **Catchment Area(sq. km):** Does

Channel Dimensions (m):	Bank Full	Wetted
Width	5.1	4.8
Thalweg Depth	0.43	0.18

Dominant Substrate: Gravel
Subdominant Substrate 1: Sand/Silt/Clay
Subdominant Substrate 2: Cobble

Rosgen Class: C4 Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well-defined floodplains.

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5	Closed Low Shrub Birch	1.5	Closed Low Willow Shrub	2
5 - 10	Open Black Spruce Forest	15	Closed Low Willow Shrub	2
10 - 20	Open Black Spruce Forest	15	Closed Low Willow Shrub	2
20 - 30	Open Black Spruce Forest	15	Closed Low Willow Shrub	2

Key To Fish Sampling Methods

(PEF) Portable Electrofisher (VOG) Visual Observation, Ground

Fish Observations

Species: Dolly Varden **Life Stage:** juvenile/adult **Life History:** Unknown
Total Fish Count: 17 **Fish Measured:** 9 **Fork Lengths (mm)** **Min:** 86 **Max:** 135 **Mean:** 108 **Median:** 110
Sampling Method (No. of fish): PEF (9) VOG (8)
Comments:

Species: Dolly Varden **Life Stage:** juvenile **Life History:** Unknown
Total Fish Count: 22 **Fish Measured:** 22 **Fork Lengths (mm)** **Min:** 42 **Max:** 79 **Mean:** 65 **Median:** 60
Sampling Method (No. of fish): PEF (22)
Comments:

Species: slimy sculpin **Life Stage:** adult **Life History:** Resident
Total Fish Count: 3 **Fish Measured:** 3 **Fork Lengths (mm)** **Min:** 72 **Max:** 75 **Mean:** 74 **Median:** 73
Sampling Method (No. of fish): PEF (3)
Comments:

Species: slimy sculpin **Life Stage:** juvenile/adult **Life History:** Resident
Total Fish Count: 16 **Fish Measured:** 6 **Fork Lengths (mm)** **Min:** 51 **Max:** 65 **Mean:** 57 **Median:** 58
Sampling Method (No. of fish): PEF (6) VOG (10)
Comments:

-continued-

Species: slimy sculpin **Life Stage:** juvenile **Life History:** Resident
Total Fish Count: 1 **Fish Measured:** 1 **Fork Lengths (mm)** **Min:** 43 **Max:** 43 **Mean:** 43 **Median:** 43
Sampling Method (No. of fish): PEF (1)
Comments:

Instruments

Stream Gradient: handheld abney level
Stream Velocity: Orange Float
Turbidity: LaMotte 2020e turbidimeter
Water Quality: YSI 556
Channel Depths: graduated wading rod
Channel Widths: measuring tape
Electrofisher: Smith-Root LR-24

FSW0917C010128.jp

FSW0917C010131.jp

Station Info

Observers: Jonathan Kirsch, Daniel Reed **Date/Time:** 08/23/2009 1:15 PM

Reach Coordinates (Upstream / Downstream)	Latitude	Longitude	/	Latitude	Latitude	Elevation NED (m)(ft): 397 1302
	64.42006	-159.64836		64.41884	-159.65062	

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83
USGS Quadrangle: Norton Bay B-2 **Legal Description (MTRS):** K012S005W27
Waterbody Name: North River
Anadromous Waters Catalog Number:
Geographic Comments:
Visit Comments:
Wildlife Comments:

Water Quality \ Stream Flow

Water Temp (C): 4.73 **DO (mg/L):** 11.43 **Conductivity (µS/cm):** 208 **Turbidity (NTU):** 0.28 **pH:** 7.69
Water Color: Clear **Thalweg Velocity (m/s)(ft/s):** 0.65 2.13

Stream Channel

Stream Gradient (%): 0.8 **Catchment Area(sq. km):** Does

Channel Dimensions (m):	Bank Full	Wetted
Width	7.2	6.8
Thalweg Depth	0.54	0.28

Dominant Substrate: Gravel
Subdominant Substrate 1: Sand/Silt/Clay
Subdominant Substrate 2: Cobble

Rosgen Class: C4 Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well-defined floodplains.

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5	Closed Low Willow Shrub	2	Closed Tall Willow Shrub	3
5 - 10	Closed Tall Willow Shrub	3	Closed Tall Willow Shrub	3
10 - 20	Closed Tall Willow Shrub	3	Closed Tall Willow Shrub	3
20 - 30	Closed Tall Willow Shrub	3	Closed Black Spruce-White Spruce Forest	15

Key To Fish Sampling Methods

(PEF) Portable Electrofisher (VOG) Visual Observation, Ground

Fish Observations

Species: Dolly Varden **Life Stage:** juvenile/adult **Life History:** Unknown
Total Fish Count: 22 **Fish Measured:** 7 **Fork Lengths (mm)** **Min:** 89 **Max:** 139 **Mean:** 111 **Median:** 114
Sampling Method (No. of fish): PEF (7) VOG (15)
Comments:

Species: Dolly Varden **Life Stage:** juvenile **Life History:** Unknown
Total Fish Count: 11 **Fish Measured:** 11 **Fork Lengths (mm)** **Min:** 54 **Max:** 81 **Mean:** 70 **Median:** 67
Sampling Method (No. of fish): PEF (11)
Comments:

Species: slimy sculpin **Life Stage:** adult **Life History:** Resident
Total Fish Count: 2 **Fish Measured:** 2 **Fork Lengths (mm)** **Min:** 72 **Max:** 83 **Mean:** 77 **Median:** 77
Sampling Method (No. of fish): PEF (2)
Comments:

Species: slimy sculpin **Life Stage:** juvenile/adult **Life History:** Resident
Total Fish Count: 5 **Fish Measured:** **Fork Lengths (mm)** **Min:** **Max:** **Mean:** **Median:**
Sampling Method (No. of fish): VOG (5)
Comments:

-continued-

Instruments

Stream Gradient: handheld abney level

Stream Velocity: Orange Float

Turbidity: LaMotte 2020e turbidimeter

Water Quality: YSI 556

Channel Depths: graduated wading rod

Channel Widths: measuring tape

Electrofisher: Smith-Root LR-24

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FSW0917C020134.jp

FSW0917C020136.jp

FSW0917C020138.jp

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FSW0917C020139.jp

Station Info

Observers: Jonathan Kirsch, Daniel Reed **Date/Time:** 08/23/2009 1:51 PM

Reach Coordinates (Upstream / Downstream)	Latitude	Longitude	Elevation NED (m)(ft): 383 1257
	64.40692	-159.72306	

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83
USGS Quadrangle: Norton Bay B-2 **Legal Description (MTRS):** K012S005W32
Waterbody Name: North River
Anadromous Waters Catalog Number:
Geographic Comments: Downstream of 17C02, below a beaver dam.
Visit Comments: E-fished only, no measurements taken.
Wildlife Comments:

Water Quality \ Stream Flow

Water Temp (C): **DO (mg/L):** **Conductivity (µS/cm):** **Turbidity (NTU):** **pH:**
Water Color: **Thalweg Velocity (m/s)(ft/s):**

Stream Channel

Stream Gradient (%): **Catchment Area(sq. km):** Does

Channel Dimensions (m): **Bank Full Width** **Wetted Thalweg Depth**
Dominant Substrate:
Subdominant Substrate 1:
Subdominant Substrate 2:
Rosgen Class:

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5				
5 - 10				
10 - 20				
20 - 30				

Key To Fish Sampling Methods

(PEF) Portable Electrofisher (VOG) Visual Observation, Ground

Fish Observations

Species: Dolly Varden **Life Stage:** adult **Life History:** Unknown
Total Fish Count: 17 **Fish Measured:** 2 **Fork Lengths (mm)** **Min:** 420 **Max:** 480 **Mean:** 450 **Median:** 450
Sampling Method (No. of fish): PEF (2) VOG (15)
Comments:

Instruments

Stream Gradient:
Stream Velocity:
Turbidity:
Water Quality:
Channel Depths:
Channel Widths:
Electrofisher: Smith-Root LR-24

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FSW0917C030140.jp

FSW0917C030141.jp

Station Info

Observers: Jonathan Kirsch, Daniel Reed **Date/Time:** 08/23/2009 3:04 PM

Reach Coordinates (Upstream / Downstream)	Latitude	Longitude	/	Latitude	Latitude	Elevation NED (m)(ft):
	64.50474	-159.78875	/	64.50389	-159.79048	426 1398

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83
USGS Quadrangle: Norton Bay C-2 **Legal Description (MTRS):** K011S006W25
Waterbody Name:
Anadromous Waters Catalog Number:
Geographic Comments:
Visit Comments:
Wildlife Comments:

Water Quality \ Stream Flow

Water Temp (C): 4.63 **DO (mg/L):** 12.38 **Conductivity (µS/cm):** 198 **Turbidity (NTU):** 0.31 **pH:** 7.76
Water Color: Clear **Thalweg Velocity (m/s)(ft/s):** 0.94 3.08

Stream Channel

Stream Gradient (%): 0.8 **Catchment Area(sq. km):** Does

Channel Dimensions (m):	Bank Full	Wetted
Width	7.0	4.8
Thalweg Depth	0.39	0.32

Dominant Substrate: Cobble
Subdominant Substrate 1: Sand/Silt/Clay
Subdominant Substrate 2: Gravel

Rosgen Class: C3 Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well-defined floodplains.

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5	Closed Tall Willow Shrub	3	Closed Tall Willow Shrub	3
5 - 10	Closed Tall Willow Shrub	3	Closed Tall Willow Shrub	3
10 - 20	Closed Tall Willow Shrub	3	Closed Tall Willow Shrub	3
20 - 30	Closed Tall Willow Shrub	3	Closed Tall Willow Shrub	3

Key To Fish Sampling Methods

(PEF) Portable Electrofisher (VOG) Visual Observation, Ground

Fish Observations

Species: Dolly Varden **Life Stage:** juvenile/adult **Life History:** Unknown
Total Fish Count: 33 **Fish Measured:** 13 **Fork Lengths (mm)** **Min:** 82 **Max:** 128 **Mean:** 105 **Median:** 105
Sampling Method (No. of fish): PEF (33)
Comments:

Species: Dolly Varden **Life Stage:** juvenile **Life History:** Unknown
Total Fish Count: 24 **Fish Measured:** 24 **Fork Lengths (mm)** **Min:** 33 **Max:** 81 **Mean:** 64 **Median:** 57
Sampling Method (No. of fish): PEF (24)
Comments:

Species: slimy sculpin **Life Stage:** adult **Life History:** Resident
Total Fish Count: 1 **Fish Measured:** 1 **Fork Lengths (mm)** **Min:** 69 **Max:** 69 **Mean:** 69 **Median:** 69
Sampling Method (No. of fish): PEF (1)
Comments:

Species: slimy sculpin **Life Stage:** juvenile/adult **Life History:** Resident
Total Fish Count: 5 **Fish Measured:** **Fork Lengths (mm)** **Min:** **Max:** **Mean:** **Median:**
Sampling Method (No. of fish): VOG (5)
Comments:

-continued-

Instruments

Stream Gradient: handheld abney level

Stream Velocity: Orange Float

Turbidity: LaMotte 2020e turbidimeter

Water Quality: YSI 556

Channel Depths: graduated wading rod

Channel Widths: measuring tape

Electrofisher: Smith-Root LR-24

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FSW0917C040142.jp

FSW0917C040143.jp

FSW0917C040144.jp

FSW0917C040145.jp

Station Info

Observers: Jonathan Kirsch, Daniel Reed **Date/Time:** 08/23/2009 4:44 PM

Reach Coordinates (Upstream / Downstream)	Latitude	Longitude	/	Latitude	Latitude	Elevation NED (m)(ft):
	64.31795	-159.86442	/	64.31742	-159.86744	328 1076

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83
USGS Quadrangle: Norton Bay B-2 **Legal Description (MTRS):** K013S006W33
Waterbody Name:
Anadromous Waters Catalog Number:
Geographic Comments:
Visit Comments:
Wildlife Comments:

Water Quality \ Stream Flow

Water Temp (C): 5.83 **DO (mg/L):** 12.11 **Conductivity (µS/cm):** 230 **Turbidity (NTU):** 0.53 **pH:** 8.20
Water Color: Clear **Thalweg Velocity (m/s)(ft/s):** 0.82 2.69

Stream Channel

Stream Gradient (%): 0.5 **Catchment Area(sq. km):** Does

Channel Dimensions (m):	Bank Full	Wetted
Width	5.3	4.4
Thalweg Depth	0.40	0.25

Dominant Substrate: Cobble
Subdominant Substrate 1: Sand/Silt/Clay
Subdominant Substrate 2: Gravel

Rosgen Class: C3 Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well-defined floodplains.

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5	Closed Tall Willow Shrub	3.5	Open Black Spruce Forest	15
5 - 10	Closed Tall Willow Shrub	3.5	Open Black Spruce Forest	15
10 - 20	Closed Tall Willow Shrub	3.5	Open Black Spruce Forest	15
20 - 30	Open Black Spruce Forest	10	Open Black Spruce Forest	15

Key To Fish Sampling Methods

(PEF) Portable Electrofisher (VOG) Visual Observation, Ground

Fish Observations

Species: Dolly Varden **Life Stage:** adult **Life History:** Unknown
Total Fish Count: 16 **Fish Measured:** 2 **Fork Lengths (mm)** **Min:** 320 **Max:** 370 **Mean:** 345 **Median:** 345
Sampling Method (No. of fish): PEF (2) VOG (14)
Comments:

Species: Dolly Varden **Life Stage:** juvenile/adult **Life History:** Unknown
Total Fish Count: 5 **Fish Measured:** 5 **Fork Lengths (mm)** **Min:** 83 **Max:** 113 **Mean:** 101 **Median:** 98
Sampling Method (No. of fish): PEF (5)
Comments:

Species: Dolly Varden **Life Stage:** juvenile **Life History:** Unknown
Total Fish Count: 5 **Fish Measured:** 5 **Fork Lengths (mm)** **Min:** 63 **Max:** 74 **Mean:** 67 **Median:** 68
Sampling Method (No. of fish): PEF (5)
Comments:

Species: slimy sculpin **Life Stage:** adult **Life History:** Resident
Total Fish Count: 3 **Fish Measured:** 3 **Fork Lengths (mm)** **Min:** 73 **Max:** 93 **Mean:** 83 **Median:** 83
Sampling Method (No. of fish): PEF (3)
Comments:

-continued-

Species: slimy sculpin **Life Stage:** juvenile/adult **Life History:** Resident
Total Fish Count: 2 **Fish Measured:** 2 **Fork Lengths (mm)** **Min:** 66 **Max:** 68 **Mean:** 67 **Median:** 67
Sampling Method (No. of fish): PEF (2)
Comments:

Species: slimy sculpin **Life Stage:** juvenile **Life History:** Resident
Total Fish Count: 1 **Fish Measured:** 1 **Fork Lengths (mm)** **Min:** 41 **Max:** 41 **Mean:** 41 **Median:** 41
Sampling Method (No. of fish): PEF (1)
Comments:

Instruments

Stream Gradient: handheld abney level
Stream Velocity: Orange Float
Turbidity: LaMotte 2020e turbidimeter
Water Quality: YSI 556
Channel Depths: graduated wading rod
Channel Widths: measuring tape
Electrofisher: Smith-Root LR-24

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FSW0917C050146.jp

FSW0917C050147.jp

FSW0917C050149.jp

Station Info

Observers: Tim Sundlov, Jacob Ivanoff **Date/Time:** 08/24/2009 12:35 PM

Reach Coordinates (Upstream / Downstream)	Latitude	Longitude	/	Latitude	Latitude	Elevation NED (m)(ft): 213 699
	64.36212	-159.99187	/	64.34398	-160.01678	

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83
USGS Quadrangle: Norton Bay B-2 **Legal Description (MTRS):** K013S007W14
Waterbody Name: North River
Anadromous Waters Catalog Number: 333-60-10100-2041
Geographic Comments: We started the fish-collection reach just downstream of 18B01.

Visit Comments: The stream velocity was measured near the end of a pool, it was the only location near the put-in that wasn't a split channel. The stream velocity was fast throughout most of the reaches, except the deep pools. Turbidity meter not working.

Wildlife Comments:

Water Quality \ Stream Flow

Water Temp (C): 5.57 **DO (mg/L):** 11.74 **Conductivity (µS/cm):** 124 **Turbidity (NTU):** **pH:** 8.20
Water Color: Clear **Thalweg Velocity (m/s)(ft/s):** 0.18 0.59

Stream Channel

Stream Gradient (%): 1 **Catchment Area(sq. km):** Does

Channel Dimensions (m):	Bank Full	Wetted	
Width	26.5	20.3	**Subdominant Substrate 1:**
Thalweg Depth	1.73	1.60	**Subdominant Substrate 2:** Cobble

Dominant Substrate: Gravel

Rosgen Class: C4 Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well-defined floodplains.

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5	Closed Low Willow Shrub	3	Closed Low Willow Shrub	3
5 - 10	Open Black Spruce Forest	15	Open Black Spruce Forest	15
10 - 20	Open Black Spruce Forest	15	Open Black Spruce Forest	15
20 - 30	Open Black Spruce Forest	15	Open Black Spruce Forest	15

Key To Fish Sampling Methods

Total Electrofishing Time (s): 2820

(BEF) Boat-Mounted Electrofisher
(DIP) Dip Net
(VOB) Visual Observation, Boat
(VOG) Visual Observation, Ground

Fish Observations

Species: Dolly Varden **Life Stage:** adult spawning **Life History:** Unknown
Total Fish Count: 71 **Fish Measured:** 3 **Fork Lengths (mm)** **Min:** 400 **Max:** 440 **Mean:** 421 **Median:** 420
Sampling Method (No. of fish): BEF (20) VOB (21) VOG (30)
Comments: These dollies are likely anadromous, based on their large size and proximity to the coast. Just below the conflue

Species: Dolly Varden **Life Stage:** juvenile/adult **Life History:** Unknown
Total Fish Count: 11 **Fish Measured:** 11 **Fork Lengths (mm)** **Min:** 88 **Max:** 143 **Mean:** 109 **Median:** 115
Sampling Method (No. of fish): BEF (11)
Comments:

Species: Dolly Varden **Life Stage:** juvenile **Life History:** Unknown
Total Fish Count: 16 **Fish Measured:** 8 **Fork Lengths (mm)** **Min:** 45 **Max:** 78 **Mean:** 56 **Median:** 61
Sampling Method (No. of fish): BEF (11) DIP (1) VOB (3) VOG (1)
Comments:

Species: Arctic grayling **Life Stage:** adult **Life History:** Resident
Total Fish Count: 3 **Fish Measured:** 2 **Fork Lengths (mm)** **Min:** 430 **Max:** 466 **Mean:** 448 **Median:** 448
Sampling Method (No. of fish): BEF (2) VOB (1)
Comments:

-continued-

Species: coho salmon **Life Stage:** adult **Life History:** Anadromous
Total Fish Count: 15 **Fish Measured:** **Fork Lengths (mm)** **Min:** **Max:** **Mean:** **Median:**
Sampling Method (No. of fish): BEF (6) VOB (7) VOG (2) **Suspected Spawning:** Yes
Comments:

Species: coho salmon **Life Stage:** juvenile **Life History:** Anadromous
Total Fish Count: 2 **Fish Measured:** 2 **Fork Lengths (mm)** **Min:** 45 **Max:** 45 **Mean:** 45 **Median:** 45
Sampling Method (No. of fish): BEF (1) DIP (1)
Comments:

Species: sockeye salmon **Life Stage:** adult spawning **Life History:** Anadromous
Total Fish Count: 2 **Fish Measured:** **Fork Lengths (mm)** **Min:** **Max:** **Mean:** **Median:**
Sampling Method (No. of fish): VOB (2)
Comments: Sockeye in sample code K was a female that was already spawned-out, but still alive--she was guarding her redd

Species: slimy sculpin **Life Stage:** adult **Life History:** Resident
Total Fish Count: 2 **Fish Measured:** 2 **Fork Lengths (mm)** **Min:** 69 **Max:** 70 **Mean:** 69 **Median:** 69
Sampling Method (No. of fish): BEF (2)
Comments:

Species: slimy sculpin **Life Stage:** juvenile/adult **Life History:** Resident
Total Fish Count: 16 **Fish Measured:** 4 **Fork Lengths (mm)** **Min:** 51 **Max:** 64 **Mean:** 58 **Median:** 57
Sampling Method (No. of fish): BEF (4) VOB (2) VOG (10)
Comments:

Species: slimy sculpin **Life Stage:** juvenile **Life History:** Resident
Total Fish Count: 1 **Fish Measured:** 1 **Fork Lengths (mm)** **Min:** 45 **Max:** 45 **Mean:** 45 **Median:** 45
Sampling Method (No. of fish): BEF (1)
Comments:

Instruments

Stream Gradient:
Stream Velocity: Price AA meter
Turbidity:
Water Quality: YSI 556
Channel Depths: graduated wading rod
Channel Widths: measuring tape
Electrofisher: Smith-Root GPP 2.5

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FSW0918B010472.jp

FSW0918B010473.jp

FSW0918B010474.jp

FSW0918B010475.jp

FSW0918B010488.jp

FSW0918B010495.jp

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FSW0918B010500.jp

Station Info

Observers: Joe Buckwalter, Daniel Reed **Date/Time:** 08/24/2009 10:05 AM

Reach Coordinates (Upstream / Downstream)	Latitude	Longitude	/	Latitude	Latitude	Elevation NED (m)(ft): 509 1670
	64.78634	-159.39201	/	64.78585	-159.39401	

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83
USGS Quadrangle: Norton Bay D-1 **Legal Description (MTRS):** K008S004W24
Waterbody Name: Egusik Creek
Anadromous Waters Catalog Number:
Geographic Comments:
Visit Comments:
Wildlife Comments:

Water Quality \ Stream Flow

Water Temp (C): 2.81 **DO (mg/L):** 12.82 **Conductivity (µS/cm):** 220 **Turbidity (NTU):** 0.17 **pH:** 7.88
Water Color: Clear **Thalweg Velocity (m/s)(ft/s):** 0.55 1.80

Stream Channel

Stream Gradient (%): 2 **Catchment Area(sq. km):** Does

Channel Dimensions (m):	Bank Full	Wetted	
			Dominant Substrate: Gravel
Width	19.5	3.4	**Subdominant Substrate 1:** Sand/Silt/Clay
Thalweg Depth	0.55	0.13	**Subdominant Substrate 2:** Cobble

Rosgen Class: F4 Entrenched meandering riffle/pool channel on low gradients with high width/depth ratio.

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5	Closed Tall Willow Shrub	1.5	Closed Low Shrub Birch-Willow Shrub	1
5 - 10	Closed Tall Willow Shrub	1.5	Closed Low Shrub Birch-Willow Shrub	1
10 - 20	Closed Tall Willow Shrub	1.5	Closed Low Shrub Birch-Willow Shrub	1
20 - 30	Closed Tall Willow Shrub	1.5	Closed Low Shrub Birch-Willow Shrub	1

Key To Fish Sampling Methods

(PEF) Portable Electrofisher

Fish Observations

Species: Dolly Varden **Life Stage:** juvenile/adult **Life History:** Unknown
Total Fish Count: 13 **Fish Measured:** 13 **Fork Lengths (mm)** **Min:** 82 **Max:** 143 **Mean:** 101 **Median:** 112
Sampling Method (No. of fish): PEF (13)
Comments:

Species: Dolly Varden **Life Stage:** juvenile **Life History:** Unknown
Total Fish Count: 40 **Fish Measured:** 19 **Fork Lengths (mm)** **Min:** 64 **Max:** 81 **Mean:** 74 **Median:** 72
Sampling Method (No. of fish): PEF (40)
Comments:

Instruments

Stream Gradient: handheld abney level
Stream Velocity: Orange Float
Turbidity: LaMotte 2020e turbidimeter
Water Quality: YSI 556
Channel Depths: graduated wading rod
Channel Widths: measuring tape
Electrofisher: Smith-Root LR-24

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FSW0918C010151.jp

FSW0918C010152.jp

FSW0918C010154.jp

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FSW0918C010155.jp

Station Info

Observers: Joe Buckwalter, Daniel Reed **Date/Time:** 08/24/2009 12:02 PM

Reach Coordinates (Upstream / Downstream) **Latitude** 64.71616 **Longitude** -159.49384 **Elevation NED (m)(ft):** 458 1503

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83

USGS Quadrangle: Norton Bay C-1 **Legal Description (MTRS):** K009S004W09

Waterbody Name:

Anadromous Waters Catalog Number:

Geographic Comments: Unnamed right-bank Shaktoolik River tributary. Waypoint marked in middle of reach (i.e., fish-collection reach extends ~75 meters up- and downstream from marked waypoint).

Visit Comments:

Wildlife Comments:

Water Quality \ Stream Flow

Water Temp (C): 2.79 **DO (mg/L):** 12.49 **Conductivity (µS/cm):** 222 **Turbidity (NTU):** 0.38 **pH:** 7.65

Water Color: Clear **Thalweg Velocity (m/s)(ft/s):** 0.28 0.92

Stream Channel

Stream Gradient (%): 0.5 **Catchment Area(sq. km):** Does

Channel Dimensions (m):	Bank Full	Wetted
Width	2.9	2.1
Thalweg Depth	0.65	0.26

Dominant Substrate: Gravel

Subdominant Substrate 1: Sand/Silt/Clay

Subdominant Substrate 2: Cobble

Rosgen Class: E4 Low gradient, meandering riffle/pool stream with low width/depth ratio and little deposition. Very efficient and stable. High meander width ratio.

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5	Closed Tall Willow Shrub	2	Closed Tall Willow Shrub	1.5
5 - 10	Closed Tall Willow Shrub	2	Closed Tall Willow Shrub	1.5
10 - 20	Closed Tall Willow Shrub	2	Open Low Mixed Shrub-Sedge Tussock Tundra	0.3
20 - 30	Closed Tall Willow Shrub	2	Open Low Mixed Shrub-Sedge Tussock Tundra	0.3

Key To Fish Sampling Methods

(PEF) Portable Electrofisher

Fish Observations

Species: Dolly Varden **Life Stage:** adult **Life History:** Resident
Total Fish Count: 1 **Fish Measured:** 1 **Fork Lengths (mm)** **Min:** 157 **Max:** 157 **Mean:** 157 **Median:** 157
Sampling Method (No. of fish): PEF (1) **Suspected Spawning:** Yes
Comments: Spawning colors.

Species: Dolly Varden **Life Stage:** juvenile/adult **Life History:** Unknown
Total Fish Count: 6 **Fish Measured:** 6 **Fork Lengths (mm)** **Min:** 105 **Max:** 144 **Mean:** 127 **Median:** 124
Sampling Method (No. of fish): PEF (6)
Comments:

Species: Dolly Varden **Life Stage:** juvenile **Life History:** Unknown
Total Fish Count: 11 **Fish Measured:** 11 **Fork Lengths (mm)** **Min:** 33 **Max:** 78 **Mean:** 52 **Median:** 55
Sampling Method (No. of fish): PEF (11)
Comments:

-continued-

Instruments

Stream Gradient: handheld abney level

Stream Velocity: Orange Float

Turbidity: LaMotte 2020e turbidimeter

Water Quality: YSI 556

Channel Depths: graduated wading rod

Channel Widths: measuring tape

Electrofisher: Smith-Root LR-24

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FSW0918C020156.jp

FSW0918C020157.jp

FSW0918C020158.jp

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FSW0918C020159.jp

Station Info

Observers: Joe Buckwalter, Daniel Reed **Date/Time:** 08/24/2009 2:26 PM

Reach Coordinates (Upstream / Downstream)	Latitude	Longitude	/	Latitude	Latitude	Elevation NED (m)(ft): 449 1473
	64.58111	-159.78533	/	64.58295	-159.78112	

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83
USGS Quadrangle: Norton Bay C-2 **Legal Description (MTRS):** K010S006W36
Waterbody Name: Brass Pan Creek
Anadromous Waters Catalog Number:
Geographic Comments:
Visit Comments:
Wildlife Comments:

Water Quality \ Stream Flow

Water Temp (C): 5.50 **DO (mg/L):** 11.80 **Conductivity (µS/cm):** 73 **Turbidity (NTU):** 0.27 **pH:** 7.66
Water Color: Clear **Thalweg Velocity (m/s)(ft/s):** 1.01 3.31

Stream Channel

Stream Gradient (%): 0.7 **Catchment Area(sq. km):** Does

Channel Dimensions (m):	Bank Full	Wetted
Width	17.7	7.7
Thalweg Depth	0.95	0.54

Dominant Substrate: Cobble
Subdominant Substrate 1:
Subdominant Substrate 2: Gravel

Rosgen Class: B3 Moderately entrenched, moderate gradient, riffle dominated channel, with infrequently spaced pools. Very stable plan and profile. Stable banks.

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5	Closed Low Scrub	0.5	Closed Tall Willow Shrub	1.5
5 - 10	Closed Low Scrub	0.5	Closed Tall Willow Shrub	1.5
10 - 20	Closed Low Scrub	0.5	Closed Low Scrub	0.5
20 - 30	Closed Low Scrub	0.5	Closed Low Scrub	0.5

Key To Fish Sampling Methods

(PEF) Portable Electrofisher (VOG) Visual Observation, Ground

Fish Observations

Species: Dolly Varden **Life Stage:** adult **Life History:** Unknown
Total Fish Count: 1 **Fish Measured:** **Fork Lengths (mm)** **Min:** **Max:** **Mean:** **Median:**
Sampling Method (No. of fish): VOG (1) **Suspected Spawning:** Yes
Comments: ~500 mm--This dolly was likely anadromous, based on its large size, proximity to saltwater, and low food availa

Species: Dolly Varden **Life Stage:** juvenile/adult **Life History:** Unknown
Total Fish Count: 9 **Fish Measured:** 9 **Fork Lengths (mm)** **Min:** 83 **Max:** 143 **Mean:** 111 **Median:** 113
Sampling Method (No. of fish): PEF (9)
Comments:

Species: Dolly Varden **Life Stage:** juvenile **Life History:** Unknown
Total Fish Count: 49 **Fish Measured:** 21 **Fork Lengths (mm)** **Min:** 48 **Max:** 80 **Mean:** 64 **Median:** 64
Sampling Method (No. of fish): PEF (49)
Comments:

Species: slimy sculpin **Life Stage:** adult **Life History:** Resident
Total Fish Count: 7 **Fish Measured:** 7 **Fork Lengths (mm)** **Min:** 84 **Max:** 102 **Mean:** 90 **Median:** 93
Sampling Method (No. of fish): PEF (7)
Comments:

-continued-

Instruments

Stream Gradient: handheld abney level

Stream Velocity: Orange Float

Turbidity: LaMotte 2020e turbidimeter

Water Quality: YSI 556

Channel Depths: graduated wading rod

Channel Widths: measuring tape

Electrofisher: Smith-Root LR-24

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FSW0918C030160.jp

FSW0918C030161.jp

FSW0918C030162.jp

FSW0918C030163.jp

Station Info

Observers: Joe Buckwalter, Daniel Reed **Date/Time:** 08/24/2009 4:59 PM

Reach Coordinates (Upstream / Downstream)	Latitude	Longitude	/	Latitude	Latitude	Elevation NED (m)(ft): 405 1329
	64.53325	-159.99801		64.53540	-159.99855	

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83
USGS Quadrangle: Norton Bay C-2 **Legal Description (MTRS):** K011S007W14
Waterbody Name:
Anadromous Waters Catalog Number:
Geographic Comments: Unnamed right-bank tributary to Kingmetolik Creek.
Visit Comments:
Wildlife Comments:

Water Quality \ Stream Flow

Water Temp (C): 5.95 **DO (mg/L):** 11.49 **Conductivity (µS/cm):** 78 **Turbidity (NTU):** 0.26 **pH:** 7.42
Water Color: Clear **Thalweg Velocity (m/s)(ft/s):** 1.15 3.77

Stream Channel

Stream Gradient (%): 1 **Catchment Area(sq. km):** Does

Channel Dimensions (m):	Bank Full	Wetted	Dominant Substrate: Cobble
Width	27.0	7.0	**Subdominant Substrate 1:**
Thalweg Depth	0.70	0.34	**Subdominant Substrate 2:** Gravel

Rosgen Class: C3 Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well-defined floodplains.

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5	Closed Tall Willow Shrub	3	Closed Tall Willow Shrub	4
5 - 10	Closed Tall Willow Shrub	3	Open White Spruce Forest	9
10 - 20	Closed Low Scrub	0.5	Open White Spruce Forest	9
20 - 30	Closed Low Scrub	0.5	Open White Spruce Forest	9

Key To Fish Sampling Methods

(PEF) Portable Electrofisher (VOG) Visual Observation, Ground

Fish Observations

Species: Dolly Varden **Life Stage:** adult **Life History:** Unknown
Total Fish Count: 3 **Fish Measured:** 1 **Fork Lengths (mm)** **Min:** 570 **Max:** 570 **Mean:** 570 **Median:** 570
Sampling Method (No. of fish): PEF (1) VOG (2) **Suspected Spawning:** Yes
Comments: Spawning colors.

Species: Dolly Varden **Life Stage:** juvenile/adult **Life History:** Unknown
Total Fish Count: 9 **Fish Measured:** 9 **Fork Lengths (mm)** **Min:** 82 **Max:** 117 **Mean:** 97 **Median:** 99
Sampling Method (No. of fish): PEF (9)
Comments:

Species: Dolly Varden **Life Stage:** juvenile **Life History:** Unknown
Total Fish Count: 48 **Fish Measured:** 21 **Fork Lengths (mm)** **Min:** 33 **Max:** 74 **Mean:** 58 **Median:** 53
Sampling Method (No. of fish): PEF (48)
Comments:

Species: slimy sculpin **Life Stage:** adult **Life History:** Resident
Total Fish Count: 2 **Fish Measured:** 2 **Fork Lengths (mm)** **Min:** 69 **Max:** 92 **Mean:** 80 **Median:** 80
Sampling Method (No. of fish): PEF (2)
Comments:

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Instruments

Stream Gradient: handheld abney level

Stream Velocity: Orange Float

Turbidity: LaMotte 2020e turbidimeter

Water Quality: YSI 556

Channel Depths: graduated wading rod

Channel Widths: measuring tape

Electrofisher: Smith-Root LR-24

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FSW0918C040166.jp

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FSW0918C040167.jp

Station Info

Observers: Jonathan Kirsch, Tim Sundlov **Date/Time:** 08/25/2009 11:13 AM

Reach Coordinates (Upstream / Downstream)	Latitude	Longitude	/	Latitude	Latitude	Elevation NED (m)(ft): 194 636
	64.70862	-160.10245	/	64.69353	-160.15851	

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83
USGS Quadrangle: Norton Bay C-3 **Legal Description (MTRS):** K009S007W17
Waterbody Name: Shaktoolik River
Anadromous Waters Catalog Number: 333-50-10100
Geographic Comments: Our take-out LZ was at the downstream target-stream waypoint (CU05B), 1.5 km downstream of the end of subreach 10. We did another subreach (11; 1.5 km long) on our way to the LZ.

Visit Comments: Tape was not long enough for a channel profile. The turbidity meter is broken.

Wildlife Comments:

Water Quality \ Stream Flow

Water Temp (C): 5.70 **DO (mg/L):** 11.61 **Conductivity (µS/cm):** 78 **Turbidity (NTU):** **pH:** 8.02
Water Color: Clear **Thalweg Velocity (m/s)(ft/s):**

Stream Channel

Stream Gradient (%): 1 **Catchment Area(sq. km):** Does

Channel Dimensions (m): **Bank Full Width** 21.5 **Thalweg Depth**
Dominant Substrate: Cobble
Subdominant Substrate 1: Sand/Silt/Clay
Subdominant Substrate 2: Gravel

Rosgen Class: C3 Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well-defined floodplains.

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5	Unvegetated		Unvegetated	
5 - 10	Closed Black Spruce Forest	20	Closed Black Spruce Forest	20
10 - 20	Closed Black Spruce Forest	20	Closed Black Spruce Forest	20
20 - 30	Closed Black Spruce Forest	20	Closed Black Spruce Forest	20

Key To Fish Sampling Methods

Total Electrofishing Time (s): 3213

(BEF) Boat-Mounted Electrofisher (VOB) Visual Observation, Boat

Fish Observations

Species: Dolly Varden **Life Stage:** adult **Life History:** Unknown
Total Fish Count: 2 **Fish Measured:** **Fork Lengths (mm)** **Min:** **Max:** **Mean:** **Median:**
Sampling Method (No. of fish): VOB (2)
Comments:

Species: Dolly Varden **Life Stage:** juvenile/adult **Life History:** Unknown
Total Fish Count: 12 **Fish Measured:** 12 **Fork Lengths (mm)** **Min:** 84 **Max:** 128 **Mean:** 107 **Median:** 106
Sampling Method (No. of fish): BEF (12)
Comments:

Species: Dolly Varden **Life Stage:** juvenile **Life History:** Unknown
Total Fish Count: 19 **Fish Measured:** 12 **Fork Lengths (mm)** **Min:** 59 **Max:** 81 **Mean:** 67 **Median:** 70
Sampling Method (No. of fish): BEF (12) VOB (7)
Comments:

Species: Arctic grayling **Life Stage:** adult **Life History:** Resident
Total Fish Count: 5 **Fish Measured:** 2 **Fork Lengths (mm)** **Min:** 410 **Max:** 443 **Mean:** 426 **Median:** 426
Sampling Method (No. of fish): BEF (2) VOB (3)
Comments:

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Species: Arctic grayling **Life Stage:** juvenile **Life History:** Resident
Total Fish Count: 3 **Fish Measured:** 3 **Fork Lengths (mm)** **Min:** 58 **Max:** 165 **Mean:** 119 **Median:** 111
Sampling Method (No. of fish): BEF (3)
Comments:

Species: Chinook salmon **Life Stage:** juvenile **Life History:** Anadromous
Total Fish Count: 2 **Fish Measured:** 2 **Fork Lengths (mm)** **Min:** 74 **Max:** 75 **Mean:** 74 **Median:** 74
Sampling Method (No. of fish): BEF (2)
Comments: See notes under subreach 11 in the Sampling Event tab.

Species: coho salmon **Life Stage:** adult **Life History:** Anadromous
Total Fish Count: 5 **Fish Measured:** **Fork Lengths (mm)** **Min:** **Max:** **Mean:** **Median:**
Sampling Method (No. of fish): VOB (5)
Comments:

Species: coho salmon **Life Stage:** juvenile **Life History:** Anadromous
Total Fish Count: 2 **Fish Measured:** 2 **Fork Lengths (mm)** **Min:** 57 **Max:** 104 **Mean:** 80 **Median:** 80
Sampling Method (No. of fish): BEF (2)
Comments:

Species: slimy sculpin **Life Stage:** adult **Life History:** Resident
Total Fish Count: 6 **Fish Measured:** 6 **Fork Lengths (mm)** **Min:** 70 **Max:** 95 **Mean:** 79 **Median:** 82
Sampling Method (No. of fish): BEF (6)
Comments:

Species: slimy sculpin **Life Stage:** juvenile/adult **Life History:** Resident
Total Fish Count: 1 **Fish Measured:** 1 **Fork Lengths (mm)** **Min:** 52 **Max:** 52 **Mean:** 52 **Median:** 52
Sampling Method (No. of fish): BEF (1)
Comments:

Species: slimy sculpin **Life Stage:** juvenile **Life History:** Resident
Total Fish Count: 9 **Fish Measured:** 9 **Fork Lengths (mm)** **Min:** 17 **Max:** 37 **Mean:** 21 **Median:** 27
Sampling Method (No. of fish): BEF (9)
Comments:

Instruments

Stream Gradient:

Stream Velocity:

Turbidity:

Water Quality: YSI 556

Channel Depths:

Channel Widths:

Electrofisher: Smith-Root GPP 2.5

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FSW0919B010533.jp

FSW0919B010534.jp

FSW0919B010543.jp

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FSW0919B010549.jp

Station Info

Observers: Joe Buckwalter, Daniel Reed **Date/Time:** 08/25/2009 10:00 AM

Reach Coordinates (Upstream / Downstream)	Latitude	Longitude	/	Latitude	Latitude	Elevation NED (m)(ft): 206 676
	64.31629	-160.41406	/	64.31703	-160.41711	

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83
USGS Quadrangle: Norton Bay B-3 **Legal Description (MTRS):** K013S009W34
Waterbody Name:
Anadromous Waters Catalog Number: 333-50-10100-2300
Geographic Comments:
Visit Comments:
Wildlife Comments:

Water Quality \ Stream Flow

Water Temp (C): **DO (mg/L):** **Conductivity (µS/cm):** **Turbidity (NTU):** 1.10 **pH:**
Water Color: Clear **Thalweg Velocity (m/s)(ft/s):** 0.52 1.71

Stream Channel

Stream Gradient (%): 1.5 **Catchment Area(sq. km):** Does

Channel Dimensions (m):	Bank Full	Wetted
Width	21.0	5.4
Thalweg Depth	0.80	0.25

Dominant Substrate: Cobble
Subdominant Substrate 1: Sand/Silt/Clay
Subdominant Substrate 2: Gravel

Rosgen Class: F4 Entrenched meandering riffle/pool channel on low gradients with high width/depth ratio.

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5	Closed Tall Willow Shrub	2	Closed Tall Willow Shrub	2
5 - 10	Closed Tall Willow Shrub	2	Closed Tall Willow Shrub	2
10 - 20	Closed Tall Willow Shrub	2	Closed Tall Willow Shrub	2
20 - 30	Open White Spruce Forest	7	Closed Tall Willow Shrub	2

Key To Fish Sampling Methods

(PEF) Portable Electrofisher

Fish Observations

Species: Dolly Varden **Life Stage:** juvenile/adult **Life History:** Unknown
Total Fish Count: 5 **Fish Measured:** 5 **Fork Lengths (mm)** **Min:** 87 **Max:** 126 **Mean:** 101 **Median:** 106
Sampling Method (No. of fish): PEF (5)
Comments:

Species: Dolly Varden **Life Stage:** juvenile **Life History:** Unknown
Total Fish Count: 33 **Fish Measured:** 24 **Fork Lengths (mm)** **Min:** 33 **Max:** 80 **Mean:** 47 **Median:** 56
Sampling Method (No. of fish): PEF (33)
Comments:

Species: Dolly Varden **Life Stage:** adult **Life History:** Unknown
Total Fish Count: 1 **Fish Measured:** 1 **Fork Lengths (mm)** **Min:** 255 **Max:** 255 **Mean:** 255 **Median:** 255
Sampling Method (No. of fish): PEF (1)
Comments:

Species: coho salmon **Life Stage:** juvenile **Life History:** Anadromous
Total Fish Count: 3 **Fish Measured:** 3 **Fork Lengths (mm)** **Min:** 30 **Max:** 46 **Mean:** 37 **Median:** 38
Sampling Method (No. of fish): PEF (3)
Comments:

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Species: slimy sculpin **Life Stage:** adult **Life History:** Resident
Total Fish Count: 1 **Fish Measured:** 1 **Fork Lengths (mm)** **Min:** 74 **Max:** 74 **Mean:** 74 **Median:** 74
Sampling Method (No. of fish): PEF (1)
Comments:

Species: slimy sculpin **Life Stage:** juvenile/adult **Life History:** Resident
Total Fish Count: 2 **Fish Measured:** 2 **Fork Lengths (mm)** **Min:** 61 **Max:** 61 **Mean:** 61 **Median:** 61
Sampling Method (No. of fish): PEF (2)
Comments:

Species: slimy sculpin **Life Stage:** juvenile **Life History:** Resident
Total Fish Count: 3 **Fish Measured:** 3 **Fork Lengths (mm)** **Min:** 47 **Max:** 49 **Mean:** 48 **Median:** 48
Sampling Method (No. of fish): PEF (3)
Comments:

Instruments

Stream Gradient: handheld abney level
Stream Velocity: Orange Float
Turbidity: LaMotte 2020e turbidimeter
Water Quality:
Channel Depths: graduated wading rod
Channel Widths: measuring tape
Electrofisher: Smith-Root LR-24

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FSW0919C010175.jp

Station Info

Observers: Joe Buckwalter, Daniel Reed **Date/Time:** 08/25/2009 11:53 AM

Reach Coordinates (Upstream / Downstream)	Latitude	Longitude	/	Latitude	Latitude	Elevation NED (m)(ft): 167 548
	64.47485	-160.44018	/	64.47356	-160.44091	

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83
USGS Quadrangle: Norton Bay B-3 **Legal Description (MTRS):** K012S009W03
Waterbody Name:
Anadromous Waters Catalog Number: 333-50-10100-2300-3021
Geographic Comments: Unnamed right-bank Anakeksik Creek tributary. Most of reach located in a beaver meadow. Active beaver ponds up-and downstream.

Visit Comments:
Wildlife Comments:

Water Quality \ Stream Flow

Water Temp (C): 5.19 **DO (mg/L):** 11.51 **Conductivity (µS/cm):** 93 **Turbidity (NTU):** 0.14 **pH:** 7.28
Water Color: Clear **Thalweg Velocity (m/s)(ft/s):** 1.00 3.28

Stream Channel

Stream Gradient (%): 0.7 **Catchment Area(sq. km):** Does

Channel Dimensions (m):	Bank Full	Wetted
Width	9.1	5.7
Thalweg Depth	0.61	0.27

Dominant Substrate: Cobble
Subdominant Substrate 1: Sand/Silt/Clay
Subdominant Substrate 2: Gravel

Rosgen Class: C3 Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well-defined floodplains.

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5	Open Tall Willow Shrub	1.5	Open Black Spruce Forest	13
5 - 10	Open Tall Willow Shrub	1.5	Open Black Spruce Forest	13
10 - 20	Open Tall Willow Shrub	1.5	Open Black Spruce Forest	13
20 - 30	Open Tall Willow Shrub	1.5	Open Black Spruce Forest	13

Key To Fish Sampling Methods

(PEF) Portable Electrofisher

Fish Observations

Species: Dolly Varden **Life Stage:** juvenile/adult **Life History:** Unknown
Total Fish Count: 13 **Fish Measured:** 13 **Fork Lengths (mm)** **Min:** 83 **Max:** 128 **Mean:** 95 **Median:** 105
Sampling Method (No. of fish): PEF (13)
Comments:

Species: Dolly Varden **Life Stage:** juvenile **Life History:** Unknown
Total Fish Count: 7 **Fish Measured:** 7 **Fork Lengths (mm)** **Min:** 64 **Max:** 79 **Mean:** 72 **Median:** 71
Sampling Method (No. of fish): PEF (7)
Comments:

Species: coho salmon **Life Stage:** juvenile **Life History:** Anadromous
Total Fish Count: 15 **Fish Measured:** 15 **Fork Lengths (mm)** **Min:** 54 **Max:** 86 **Mean:** 69 **Median:** 70
Sampling Method (No. of fish): PEF (15)
Comments: Coho were taken from side-channel pools behind blown-out beaver dams.

Instruments

Stream Gradient: handheld abney level
Stream Velocity: Orange Float
Turbidity: LaMotte 2020e turbidimeter
Water Quality: YSI 556
Channel Depths: graduated wading rod
Channel Widths: measuring tape
Electrofisher: Smith-Root LR-24

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FSW0919C020317.jp

Station Info

Observers: Joe Buckwalter, Daniel Reed **Date/Time:** 08/25/2009 2:27 PM

Reach Coordinates (Upstream / Downstream)	Latitude	Longitude	/	Latitude	Latitude	Elevation NED (m)(ft): 355 1165
	64.43340	-160.24200	/	64.43440	-160.23757	

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83
USGS Quadrangle: Norton Bay B-3 **Legal Description (MTRS):** K012S008W22
Waterbody Name: Kingmetolik Creek
Anadromous Waters Catalog Number: 333-50-10100-2410
Geographic Comments:
Visit Comments:
Wildlife Comments:

Water Quality \ Stream Flow

Water Temp (C): 6.40 **DO (mg/L):** 11.47 **Conductivity (µS/cm):** 66 **Turbidity (NTU):** 0.12 **pH:** 7.29
Water Color: Clear **Thalweg Velocity (m/s)(ft/s):** 0.50 1.64

Stream Channel

Stream Gradient (%): 1 **Catchment Area(sq. km):** Does

Channel Dimensions (m):	Bank Full	Wetted
Width	10.0	7.9
Thalweg Depth	0.90	0.45

Dominant Substrate: Cobble
Subdominant Substrate 1: Sand/Silt/Clay
Subdominant Substrate 2: Gravel

Rosgen Class: C3 Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well-defined floodplains.

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5	Closed Tall Willow Shrub	1.5	Closed Tall Willow Shrub	2
5 - 10	Closed Tall Willow Shrub	1.5	Closed Tall Willow Shrub	2
10 - 20	Closed Low Scrub	0.5	Closed Tall Willow Shrub	2
20 - 30	Closed Low Scrub	0.5	Closed Tall Willow Shrub	2

Key To Fish Sampling Methods

(PEF) Portable Electrofisher

Fish Observations

Species: Dolly Varden **Life Stage:** juvenile/adult **Life History:** Unknown
Total Fish Count: 7 **Fish Measured:** 7 **Fork Lengths (mm)** **Min:** 90 **Max:** 126 **Mean:** 109 **Median:** 108
Sampling Method (No. of fish): PEF (7)
Comments:

Species: Dolly Varden **Life Stage:** juvenile **Life History:** Unknown
Total Fish Count: 11 **Fish Measured:** 8 **Fork Lengths (mm)** **Min:** 43 **Max:** 75 **Mean:** 50 **Median:** 59
Sampling Method (No. of fish): PEF (11)
Comments:

Species: coho salmon **Life Stage:** juvenile **Life History:** Anadromous
Total Fish Count: 15 **Fish Measured:** 14 **Fork Lengths (mm)** **Min:** 32 **Max:** 81 **Mean:** 45 **Median:** 56
Sampling Method (No. of fish): PEF (15)
Comments:

Species: slimy sculpin **Life Stage:** adult **Life History:** Resident
Total Fish Count: 2 **Fish Measured:** 2 **Fork Lengths (mm)** **Min:** 70 **Max:** 80 **Mean:** 75 **Median:** 75
Sampling Method (No. of fish): PEF (2)
Comments:

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Species: slimy sculpin **Life Stage:** juvenile/adult **Life History:** Resident
Total Fish Count: 9 **Fish Measured:** 9 **Fork Lengths (mm)** **Min:** 50 **Max:** 68 **Mean:** 57 **Median:** 59
Sampling Method (No. of fish): PEF (9)
Comments:

Species: slimy sculpin **Life Stage:** juvenile **Life History:** Resident
Total Fish Count: 6 **Fish Measured:** 6 **Fork Lengths (mm)** **Min:** 42 **Max:** 48 **Mean:** 45 **Median:** 45
Sampling Method (No. of fish): PEF (6)
Comments:

Instruments

Stream Gradient: handheld abney level
Stream Velocity: Orange Float
Turbidity: LaMotte 2020e turbidimeter
Water Quality: YSI 556
Channel Depths: graduated wading rod
Channel Widths: measuring tape
Electrofisher: Smith-Root LR-24

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FSW0919C030322.jp

Station Info

Observers: Joe Buckwalter, Daniel Reed **Date/Time:** 08/25/2009 4:35 PM

Reach Coordinates (Upstream / Downstream)	Latitude	Longitude	/	Latitude	Latitude	Elevation NED (m)(ft): 386 1266
	64.44188	-160.09480	/	64.44360	-160.09756	

Coordinate Determination Method: Non-Differential GPS Field Measurement **Datum:** NAD83
USGS Quadrangle: Norton Bay B-3 **Legal Description (MTRS):** K012S007W16
Waterbody Name:
Anadromous Waters Catalog Number:
Geographic Comments: Unnamed right-bank Kingmetolik Creek tributary.
Visit Comments:
Wildlife Comments:

Water Quality \ Stream Flow

Water Temp (C): 5.56 **DO (mg/L):** 13.45 **Conductivity (µS/cm):** 55 **Turbidity (NTU):** 0.00 **pH:** 7.42
Water Color: Clear **Thalweg Velocity (m/s)(ft/s):** 0.80 2.62

Stream Channel

Stream Gradient (%): 0.7 **Catchment Area(sq. km):** Does

Channel Dimensions (m):	Bank Full	Wetted
Width	6.8	4.3
Thalweg Depth	0.73	0.35

Dominant Substrate: Cobble
Subdominant Substrate 1: Boulder
Subdominant Substrate 2: Gravel

Rosgen Class: C3 Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well-defined floodplains.

Riparian Vegetation Communities (Viereck et al. 1992)

Dist. from Bank (m)	Left Bank Vegetation Type	Canopy Height(m)	Right Bank Vegetation Type	Canopy Height(m)
0 - 5	Open Tall Willow Shrub	3	Closed Tall Willow Shrub	2
5 - 10	Open Tall Willow Shrub	3	Closed Tall Willow Shrub	2
10 - 20	Closed Tall Willow Shrub	3	Closed Tall Willow Shrub	2
20 - 30	Closed Tall Willow Shrub	3	Closed Low Scrub	0.5

Key To Fish Sampling Methods

(PEF) Portable Electrofisher (VOG) Visual Observation, Ground

Fish Observations

Species: Dolly Varden **Life Stage:** adult **Life History:** Resident
Total Fish Count: 1 **Fish Measured:** 1 **Fork Lengths (mm)** **Min:** 147 **Max:** 147 **Mean:** 147 **Median:** 147
Sampling Method (No. of fish): PEF (1)
Comments:

Species: Dolly Varden **Life Stage:** adult **Life History:** Unknown
Total Fish Count: 1 **Fish Measured:** **Fork Lengths (mm)** **Min:** **Max:** **Mean:** **Median:**
Sampling Method (No. of fish): VOG (1) **Suspected Spawning:** Yes
Comments: ~500mm; Spawning colors. This dolly was likely anadromous, based on its large size, proximity to saltwater, an

Species: Dolly Varden **Life Stage:** juvenile/adult **Life History:** Unknown
Total Fish Count: 5 **Fish Measured:** 5 **Fork Lengths (mm)** **Min:** 82 **Max:** 127 **Mean:** 101 **Median:** 104
Sampling Method (No. of fish): PEF (5)
Comments:

Species: Dolly Varden **Life Stage:** juvenile **Life History:** Unknown
Total Fish Count: 69 **Fish Measured:** 24 **Fork Lengths (mm)** **Min:** 29 **Max:** 80 **Mean:** 49 **Median:** 54
Sampling Method (No. of fish): PEF (69)
Comments:

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Instruments

Stream Gradient: handheld abney level

Stream Velocity: Orange Float

Turbidity: LaMotte 2020e turbidimeter

Water Quality: YSI 556

Channel Depths: graduated wading rod

Channel Widths: measuring tape

Electrofisher: Smith-Root LR-24

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